Roundabout Prequalification Training

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Presenters

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Why Roundabouts?

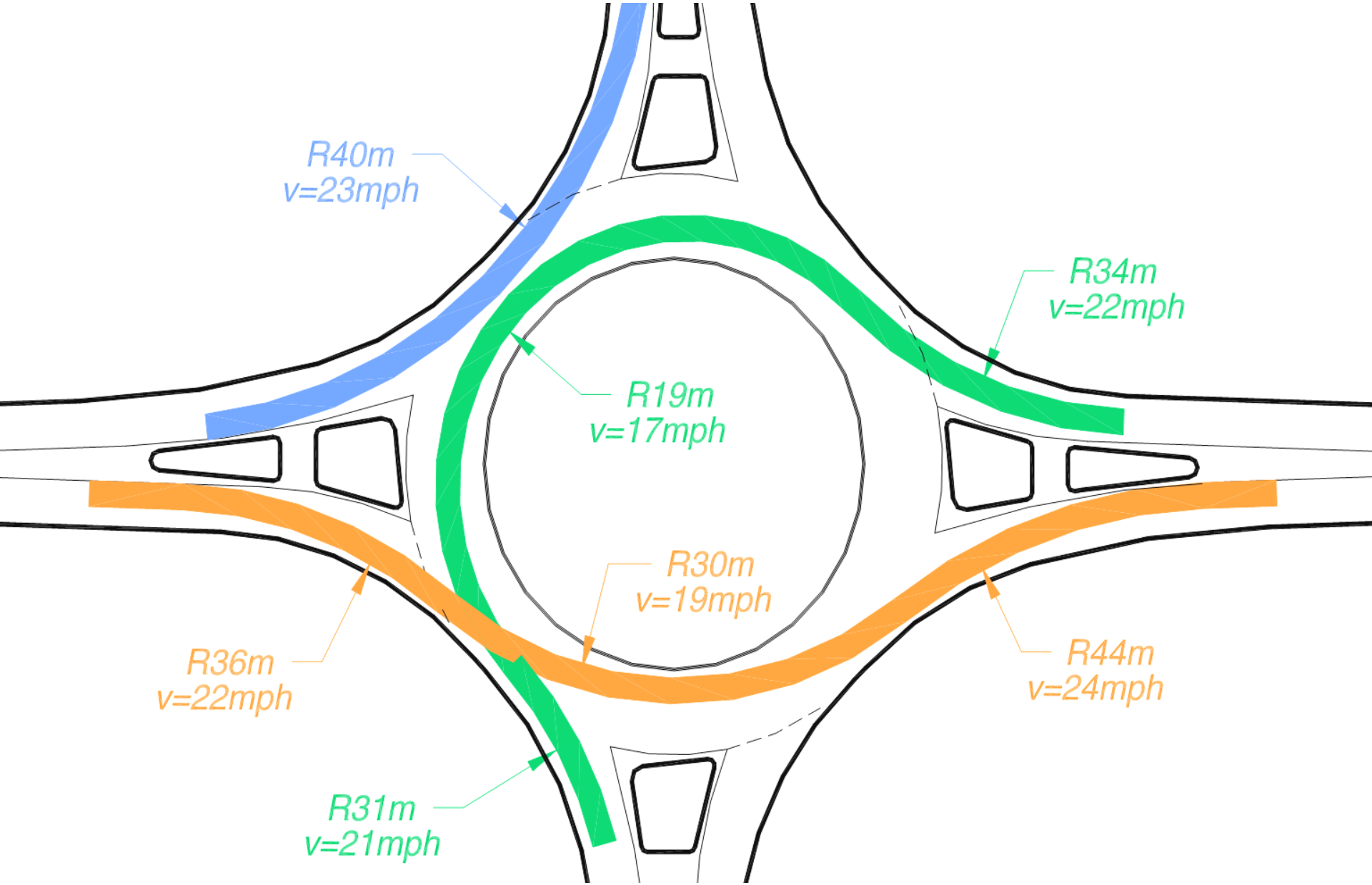
- Everybody else is building them?
- They look cool?
- Circles are better than squares?
- We want to be like the Europeans?

SAFETY!

According to Insurance Institute for Highway Safety (IIHS):

- In 2012, 683 people were killed and approximately 133,000 were injured in the U.S. in crashes that involved red light running
- Roundabouts have 79% fewer accidents with injuries than ordinary intersections and 90% fewer fatalities
- Since 2000, IIHS has issued a total of five reports promoting the use of roundabouts

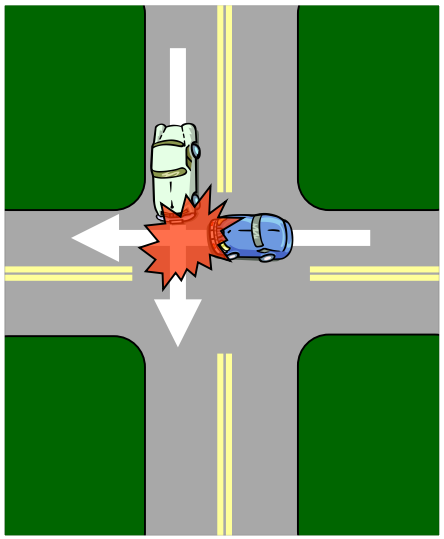
Safety - Speed Reduction



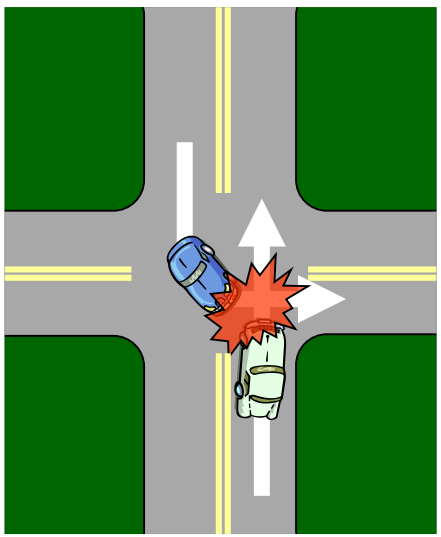
Safety - Type of Crashes

Typical 4-leg intersection

Angle

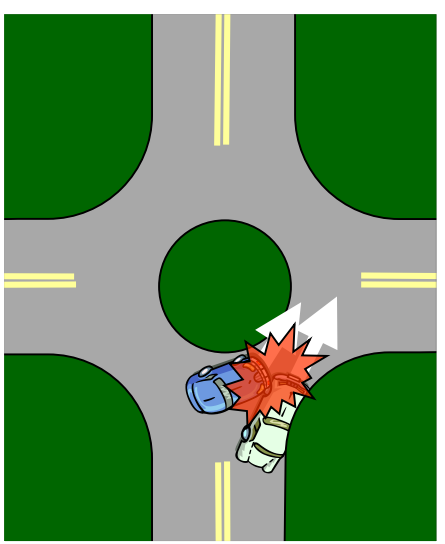


Left turn

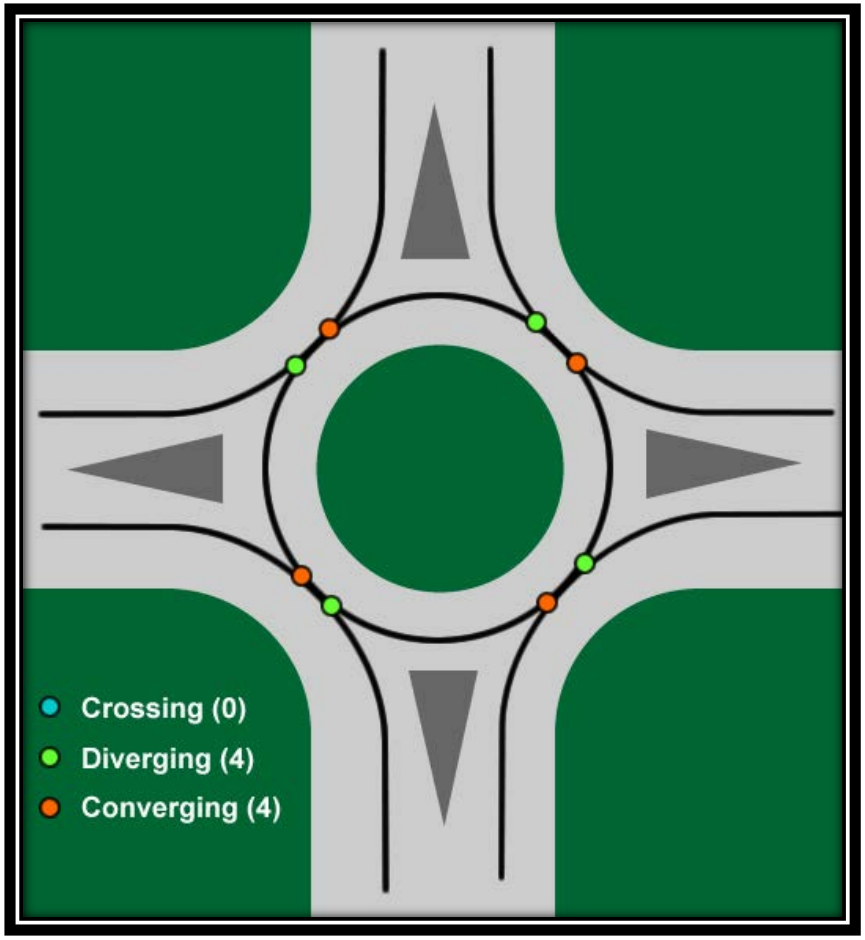


Roundabout

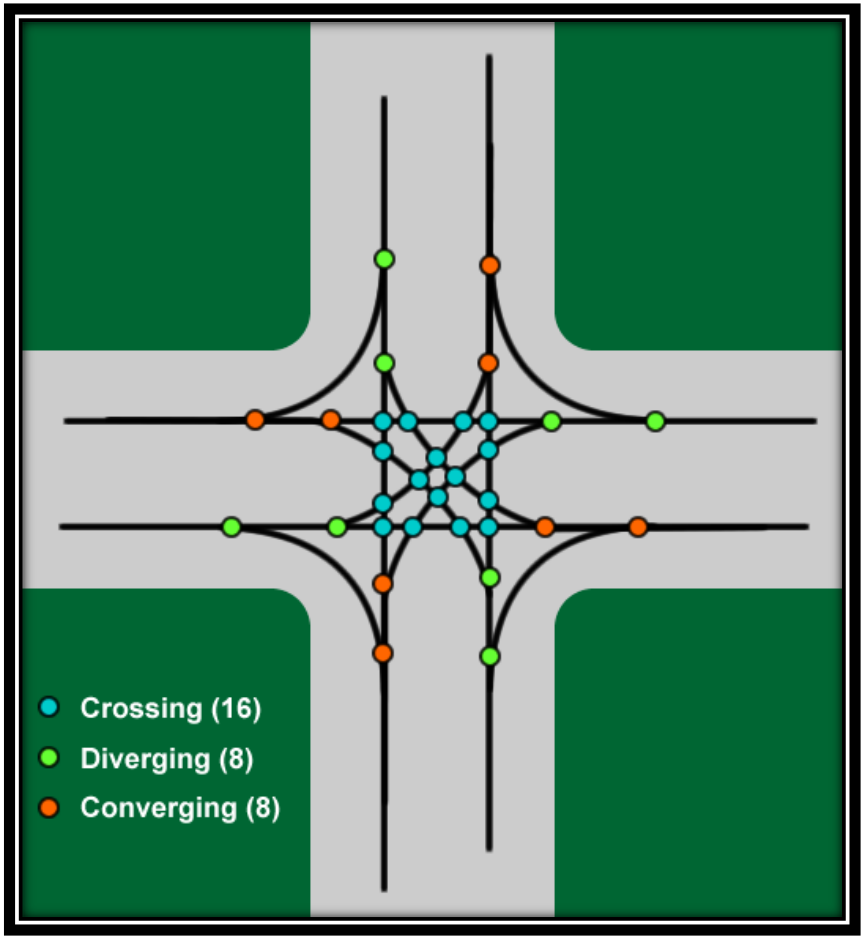
Sideswipe



Safety - Vehicular Conflict Points



Total Conflict Points: 8



Total Conflict Points: 32

Why Roundabouts?

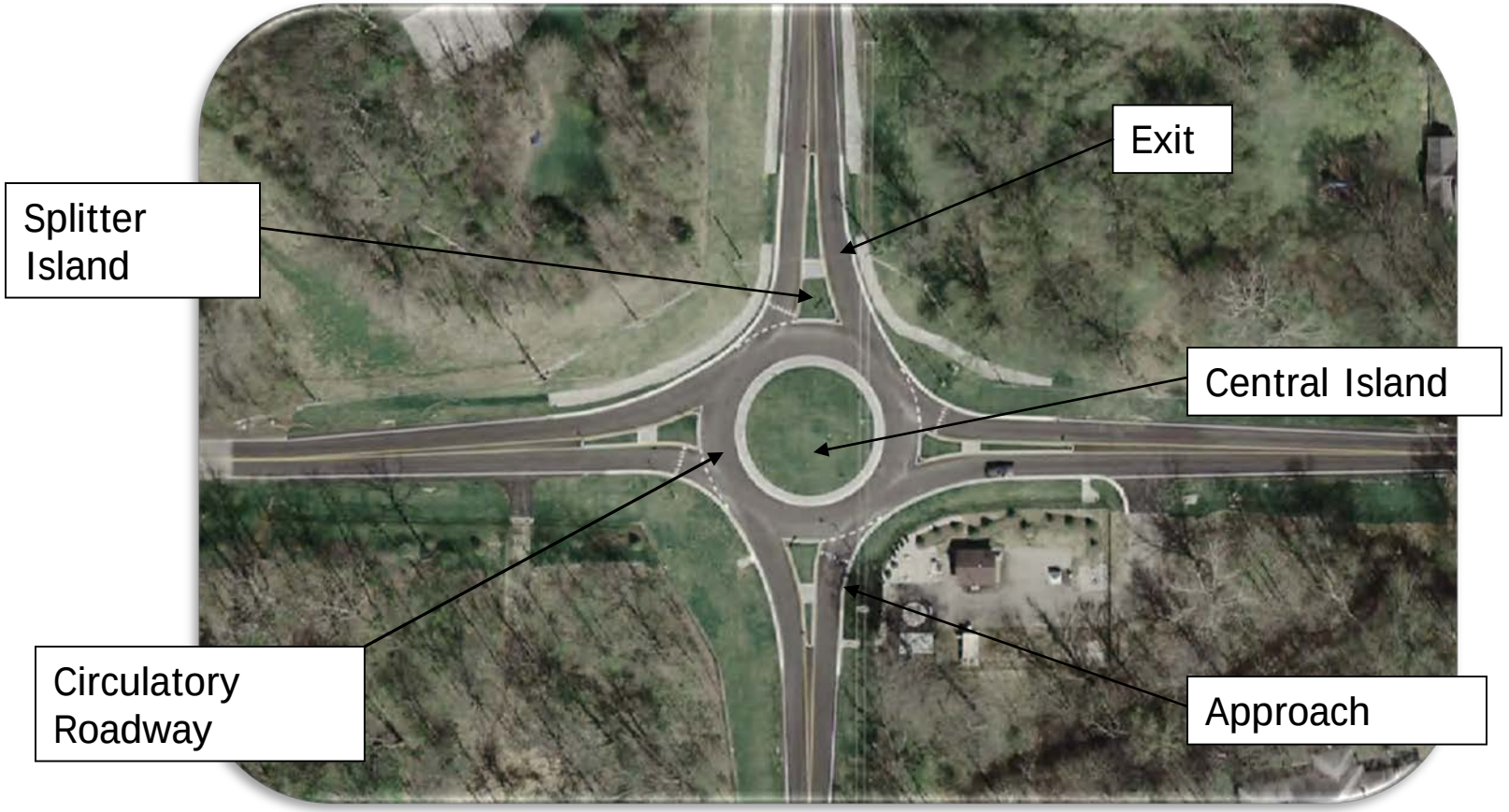
- INDOT desires roundabouts to be considered for any intersection improvement project
- Another tool in the toolbox
- Not always the answer, but often you'll be surprised!

Why Prequalification?

- Proven safety measure
- INDOT desires roundabouts to be considered in your planning process
- Sound design plays a major role in the function of a roundabout
- Understanding the important parameters of roundabouts is crucial to sound design

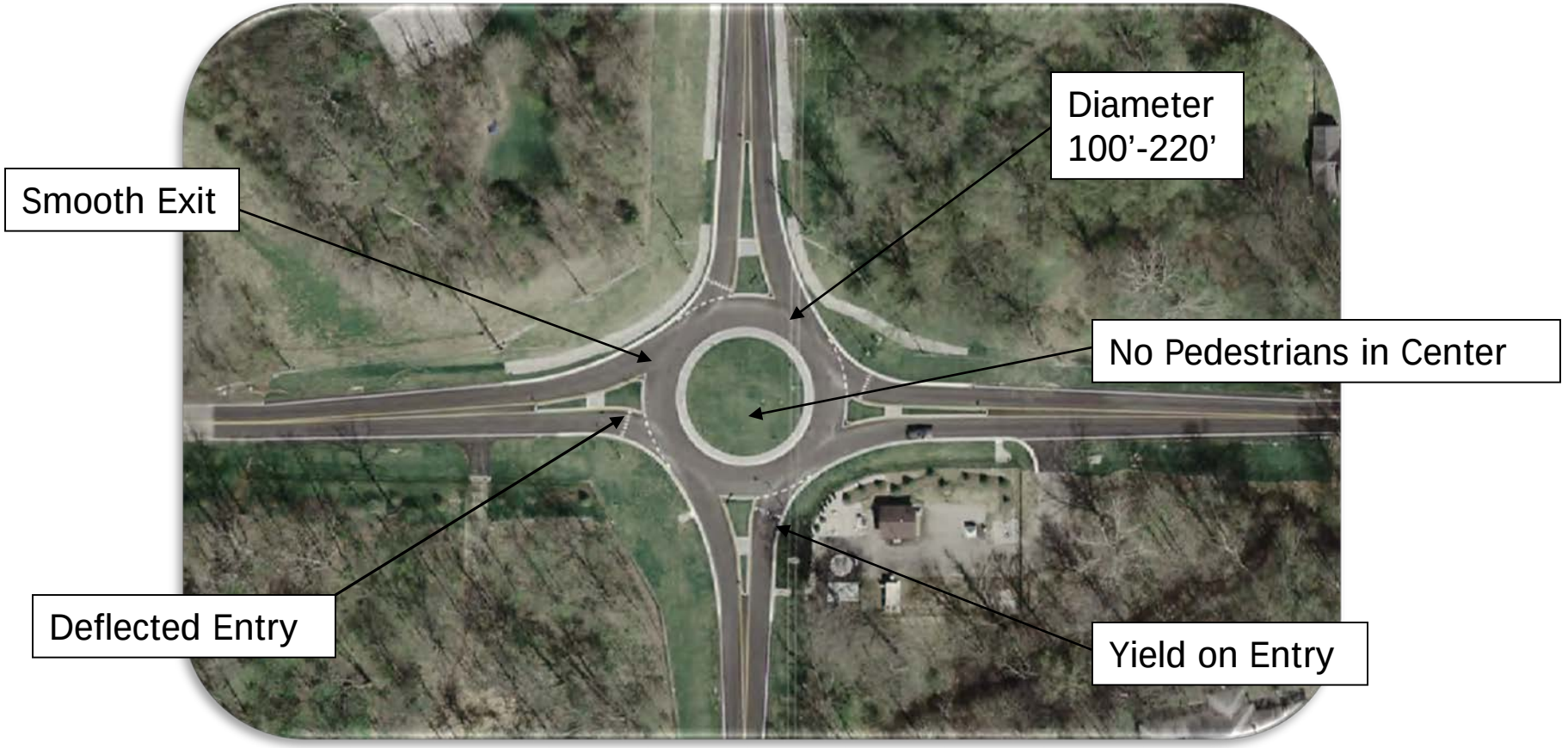
Roundabout Basics & Background

Definitions



Roundabout Basics & Background

What makes a Modern Roundabout?

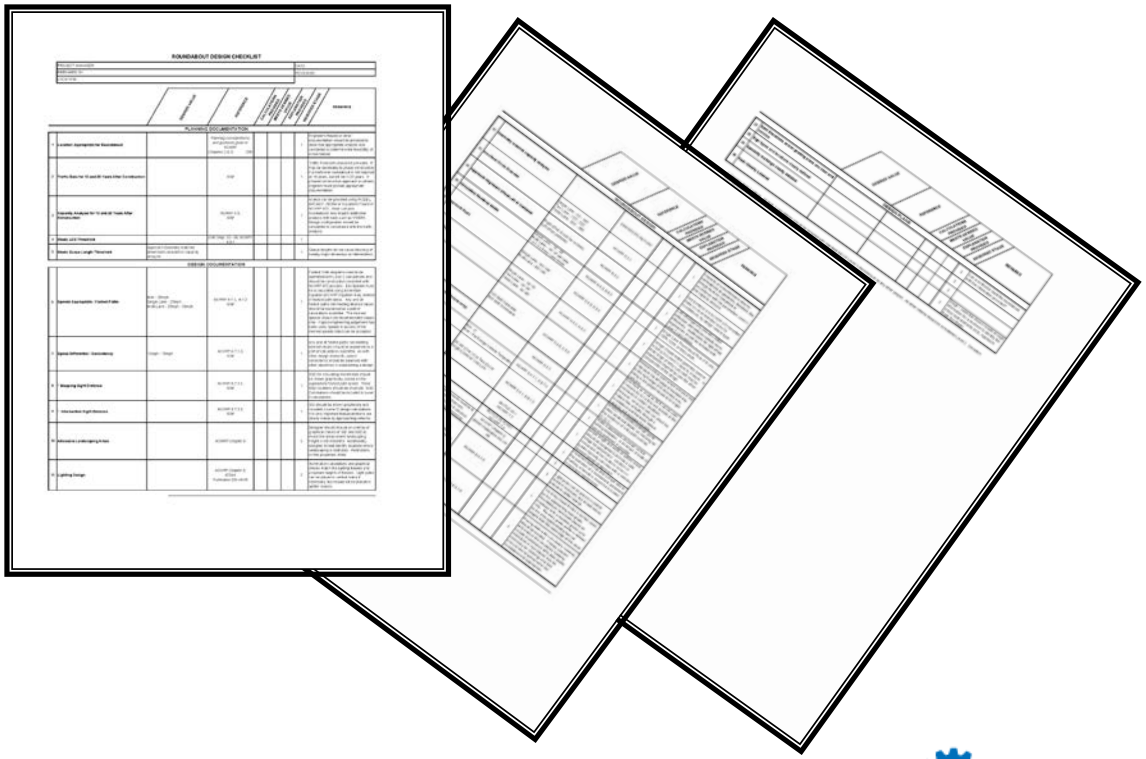


INDOT Roundabout Design Policy

- FHWA Guide (NCHRP 672)
- 2009 MUTCD (pavement markings and signage)
- HCM 2010 (operations)
- IDM Chapter 51-12.0 (written prior to NCHRP 672)
- To be replaced by IDM 305-5.0 (supplement to NCHRP 672)
- Meantime: Design Memo 13-10

Roundabout Design Checklist

Purpose: *To provide guidance to designers and reviewers on many of the major items to be considered during the design of roundabouts*



Roundabout Design Checklist

- Not a comprehensive list nor a set of hard and fast rules
- Documentation is critical for reviewers to understand the designer's intentions
- Diverging from the ranges outside of the desirable ranges shown is acceptable but needs to be justified with design documentation

Roundabout Design Checklist

- Divided into four major categories
  - Planning
  - Design Documentation
  - Roundabout Design
  - Design Plans
- Designers should submit completed checklist and documentation with all roundabout submittals

Roundabout Planning

Scoping and Justification of Alternatives

"A comparison of roundabout practicality/feasibility vs. other intersection types should be conducted, taking into consideration safety, traffic operations, capacity, ROW impacts, and cost."

Roundabout Planning

Evaluation Criteria

- Operations
- Safety
- R/W impacts
- Construction cost
- User costs
- Constructability
- Public input
- Maintenance of traffic
- Noise and environmental impacts

Roundabout Planning

Locations Where Roundabouts Can Be Beneficial

- High-speed rural intersections
- Locations with mediocre/poor crash history
- Locations with traffic operational problems
- Closely spaced intersections
- Near structures, including freeway interchange ramps
- Access management
- Gateway or transition locations
- Where community enhancement is desired
- Near schools
- Corridors

Roundabout Planning

Locations Where Roundabouts Can Be Beneficial – Corridors

- NCHRP Report 772 recently completed. Provides framework for analyzing a roundabout corridor vs. a signal or stop controlled corridor
- Our experience: work very well when all roundabouts are operating under capacity
- No need to coordinate timings
- Every vehicle on every approach must slow down to enter the roundabout
- Slower speeds increase motorist and pedestrian safety

Roundabout Planning

Location – Proceed with Caution

- Within a system of coordinated signals
- On a steep grade
- Where stopping sight distance cannot be achieved
- Near rail crossings
- Near a signalized intersection

Roundabout Planning
Documentation

Memo or report with the following, where applicable:

- Traffic volumes and crash history
- 20-year traffic projections
- Capacity analysis
- Conceptual geometric design
- Public involvement
- Comparison to other intersection types, including “Do Nothing”
- Crash analysis
- Selection of preferred option

Use INDOT “Intersection Decision Guide”

Roundabout Planning

Traffic Data

- 20-year forecasts
- Consider staged construction

  Interim year analysis required
- Turning movements critical

  Roundabout capacity dependent on approach and conflicting circulating traffic

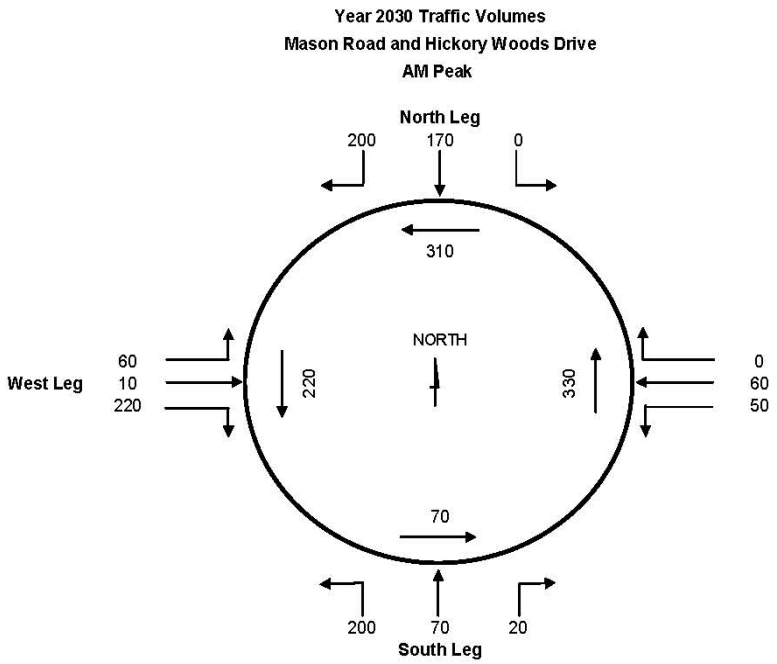
Roundabout Planning

Traffic Data – Calculating Volumes

Intersection	Mason Road and Hickory Woods Drive
Peak Hour	AM Peak
Analyst	TW

Base Year	2009
Forecast Year	2030
Annual Growth Rate (%)	2.00

	South Leg			North Leg			West Leg			East Leg			
	LEFT	THRU	RIGHT	LEFT	THRU	RIGHT	LEFT	THRU	RIGHT	LEFT	THRU	RIGHT	
YEAR													HOUR TOTAL
2009	140	51	12	2	119	144	45	10	154	33	41	2	753
2030	200	70	20	0	170	200	60	10	220	50	60	0	1060
Excluded													



Approach-Based Totals For Peak Hour

Leg	Direction	Count
North Leg	Leaving	130
	Approaching	370
East Leg	Leaving	30
	Approaching	110
South Leg	Leaving	440
	Approaching	290
West Leg	Leaving	460
	Approaching	290

Roundabout Planning

Capacity Analysis - Tools

Capacity Analysis (Macroscopic):

- RODEL / ARCADY
- SIDRA Intersection
- Equations from FHWA Roundabout Guide
- Equations from NCHRP Report 572 “Roundabouts in the United States” (published in 2007)
- HCM 2010 (HCS 2010, Synchro, SIDRA, etc.)

Simulations (Microscopic):

- Vissim
- Paramics
- Others

Roundabout Planning

Capacity Analysis - Tools

- Roundabout geometric features used in design should match those in the capacity analysis if a capacity model with geometry inputs is being used (ARCADY, RODEL, SIDRA)
- Learn the theory, limitations, and strengths of the software that you are using!

Roundabout Planning

Capacity – Approach vs. Circulating Flow

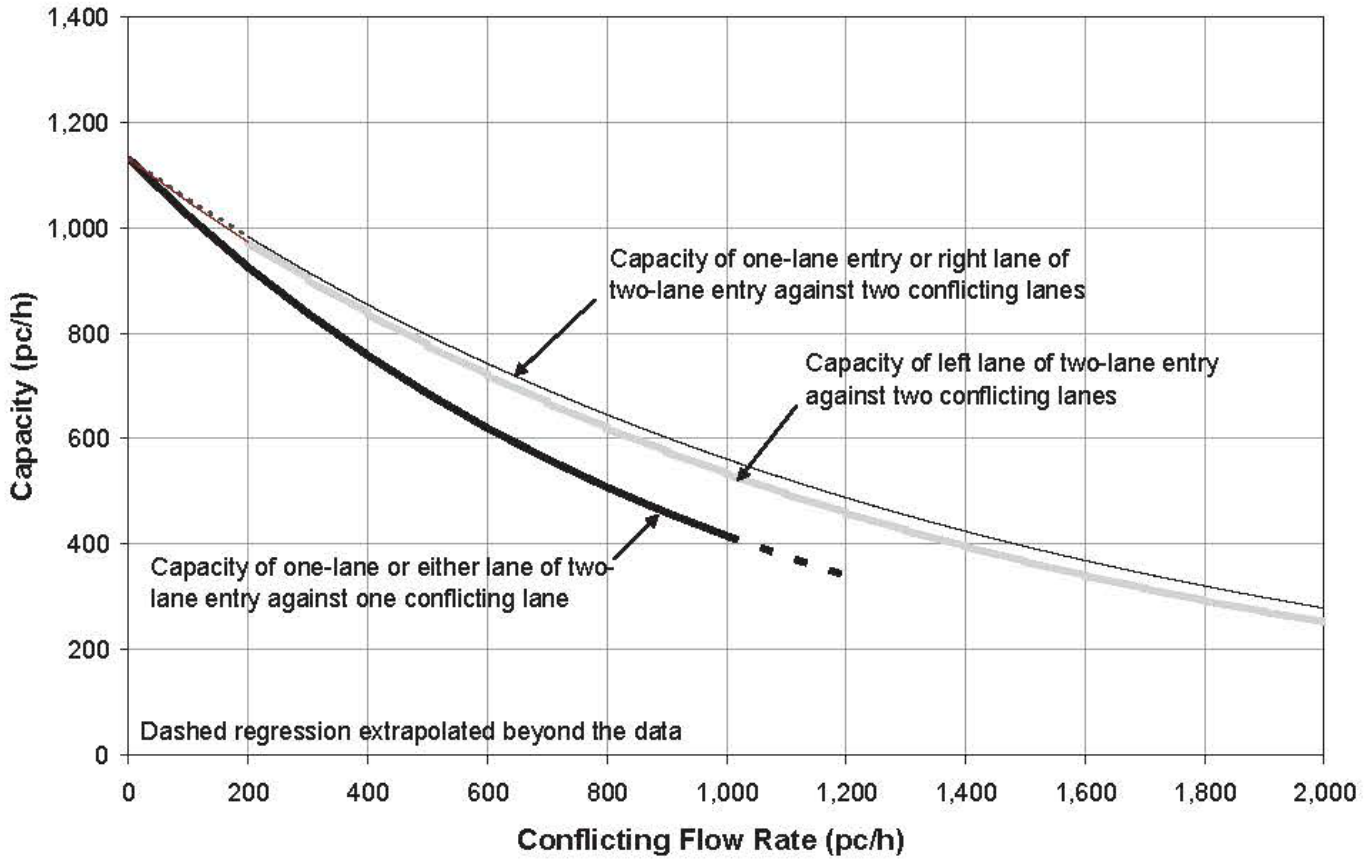


Figure 4-6 NCHRP 672
(Based on HCM 2010)

Roundabout Planning

Capacity – Rules of Thumb

- Single-lane roundabouts – up to 25,000 vpd
- Two-lane roundabouts – up to 40,000 vpd
- Three-lane roundabouts – in excess of 55,000 vpd
- Highly dependent upon turning movement percentages
- Rule of Thumb: Single lane approach volume = 1,100 – 1,200 vph

Roundabout Planning

Capacity – LOS Requirements

Roundabout level of service is similar to that of an unsignalized intersection.

Control Delay (s/veh)	Level of Service by Volume-to-Capacity Ratio*	
	v/c ≤ 1.0	v/c >1.0
0–10	A	F
>10–15	B	F
>15–25	C	F
>25–35	D	F
>35–50	E	F
>50	F	F

* For approaches and intersection-wide assessment, LOS is defined solely by control delay.

NCHRP Report 672 – Exhibit 4-9

(based on HCM)

Level of service should meet the IDM thresholds for different facility types. (Currently Chapters 53-56)

Design Element				Manual Section	2 Lanes			4 or More Lanes	
Design Controls	Design-Year Traffic, AADT			40-2.01	< 400	400 ≤ AADT < 2000	≥ 2000	**Undivided	Divided
	Design Forecast Period			40-2.02	20 Years			20 Years	
	*Design Speed, mph (1)			40-3.0	Level: 60 – 70; Rolling: 50 – 60			60	60-70
	Access Control			40-5.0	Partial Control / None			Partial Control / None	
	Level of Service			40-2.0	Desirable: B; Minimum: C			Desirable: B; Minimum: C	
Cross-Section Elements**	Travel Lane	*Width		45-1.01	12 ft			12 ft	
		Typical Surface Type (2)		Chp. 52	Asphalt / Concrete			Asphalt / Concrete	
	Shoulder (3)	*Width Usable		45-1.02	6 ft	8 ft	11 ft (3b)	11 ft (3b)	Right: 11 ft (3b) Left: 4 ft (3e)
		*Width Paved		45-1.02	4 ft	6 ft	10 ft (3b)	10 ft (3b)	Right: 10 ft (3b) Left: 4 ft (3e)
		Typical Surface Type (2)		Chp. 52	Asphalt / Concrete			Asphalt / Concrete	
	Cross Slope	*Travel Lane (4)		45-1.01	2%			2%	
		Shoulder (4A)		45-1.02	Paved Width ≤ 4 ft: 2%; Paved Width > 4 ft: 4%			Paved Width ≤ 4 ft: 2%; Paved Width > 4 ft: 4%	
	Auxiliary Lane	Lane Width (5)		45-1.03	Desirable: 12 ft; Minimum: 11 ft			Desirable: 12 ft; Minimum: 11 ft	
		Shoulder Width (6)			Same as Next to Travel Lane			Same as Next to Travel Lane	
	Median Width			45-2.0	N/A			0.0 ft	Desirable: 80 ft Minimum: 16 ft (7)
	Clear-Zone Width			49-2.0	(8)			(8)	
	Side Slopes (9)	Cut	Foreslope	45-3.0	6:1 (10)			6:1 (10)	
			Ditch Width		4 ft (11)			4 ft (11)	
			Backslope		4:1 for 20 ft; 3:1 Max. to Top (12)			4:1 for 20 ft; 3:1 Max. to Top (12)	
		Fill		45-3.0	6:1 to Clear Zone; 3:1 Max. to Toe			6:1 to Clear Zone; 3:1 Max. to Toe	
	Median Slopes			45-2.02	N/A			Desirable: 8:1; Maximum: 5:1	
Bridges***	New or Reconstructed Bridge	*Structural Capacity		Chp. 60	HL-93 (13)				
		*Clear-Roadway Width(14)		45-4.01	Full Paved Approach Width				
	Existing Bridge to Remain in Place	*Structural Capacity		Chp. 72	HS-20				
		*Clear-Roadway Width		45-4.01	Travelway Plus 2 ft on Each Side				
	*Vertical Clearance, Arterial Under	New or Replaced Overpassing Bridge (15)		44-4.0	16.5 ft				
		Existing Overpassing Bridge			14 ft				
		Sign Truss / Pedestrian Bridge (15)			New: 17.5 ft; Existing: 17 ft				
	Vertical Clearance, Arterial Over Railroad (16)			Chp. 69	23 ft				

* Controlling design criterion. ** An arterial of 4 or more lanes on a new location should be designed as Divided.
*** Selection of the cross section and bridge elements is based on the design-year traffic volume irrespective of the design speed.

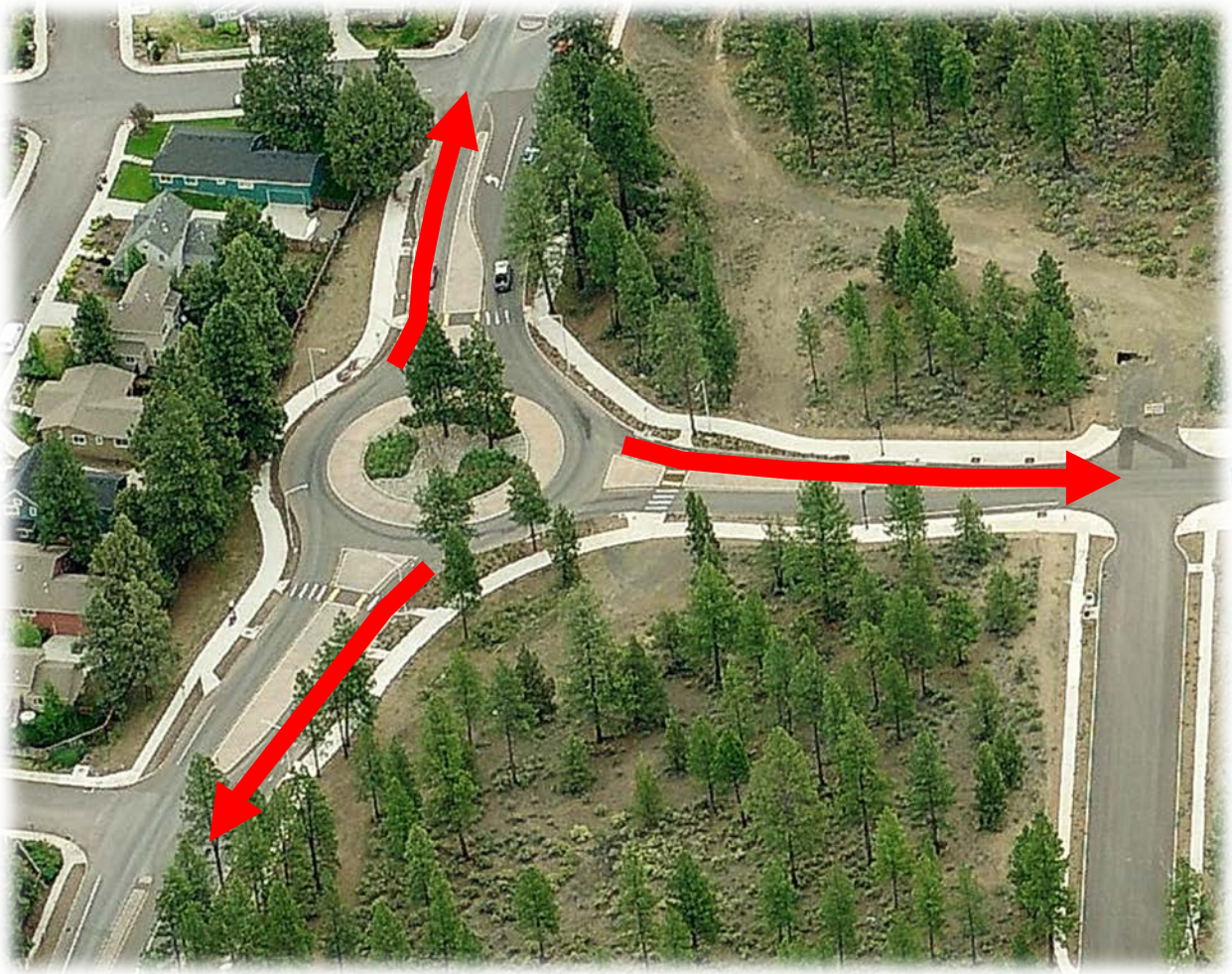
GEOMETRIC DESIGN CRITERIA FOR RURAL ARTERIAL
(New Construction or Reconstruction)

Figure 53-2

Roundabout Planning

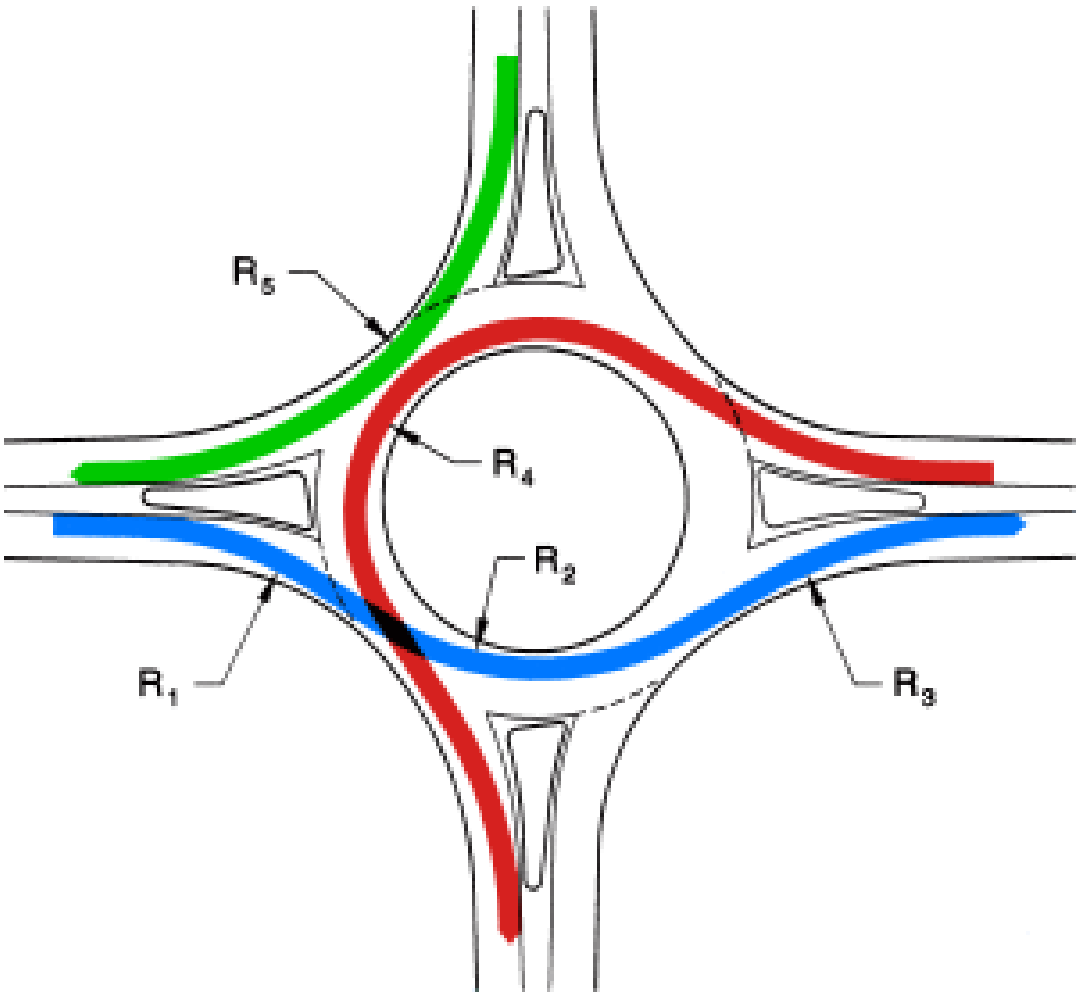
Queue Length

Calculated queue lengths should not cause blocking of nearby drives or intersections (95th percentile queue length)



Design Documentation

Speeds Appropriate / Fastest Paths



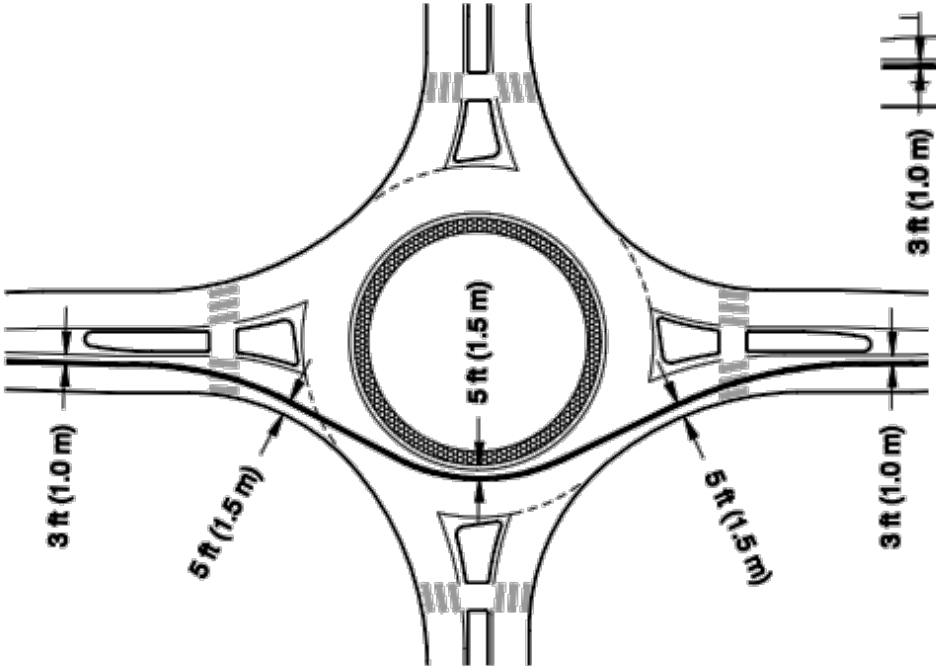
- Definitions of paths per FHWA Guide
- Refer to NCHRP 672 Sections 6.7.1 and 6.7.2
- R1-R2-R3 movement is typically fastest path

Design Documentation

Speeds Appropriate / Fastest Paths

NCHRP 672 provides illustrations of how to create these paths...

Exhibit 6-48



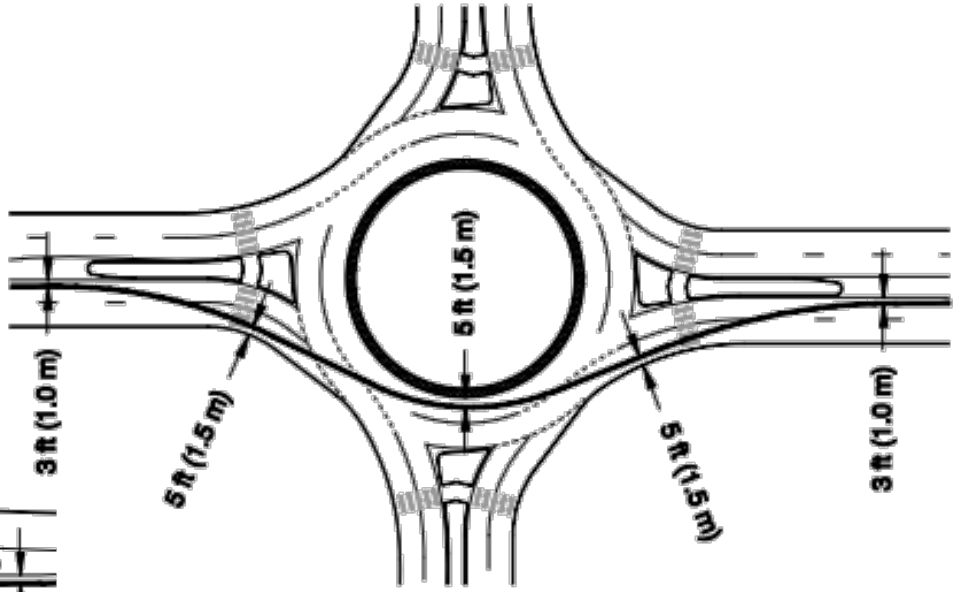


Exhibit 6-49

Design Documentation

Speeds Appropriate / Fastest Paths

...and how to measure the radii...

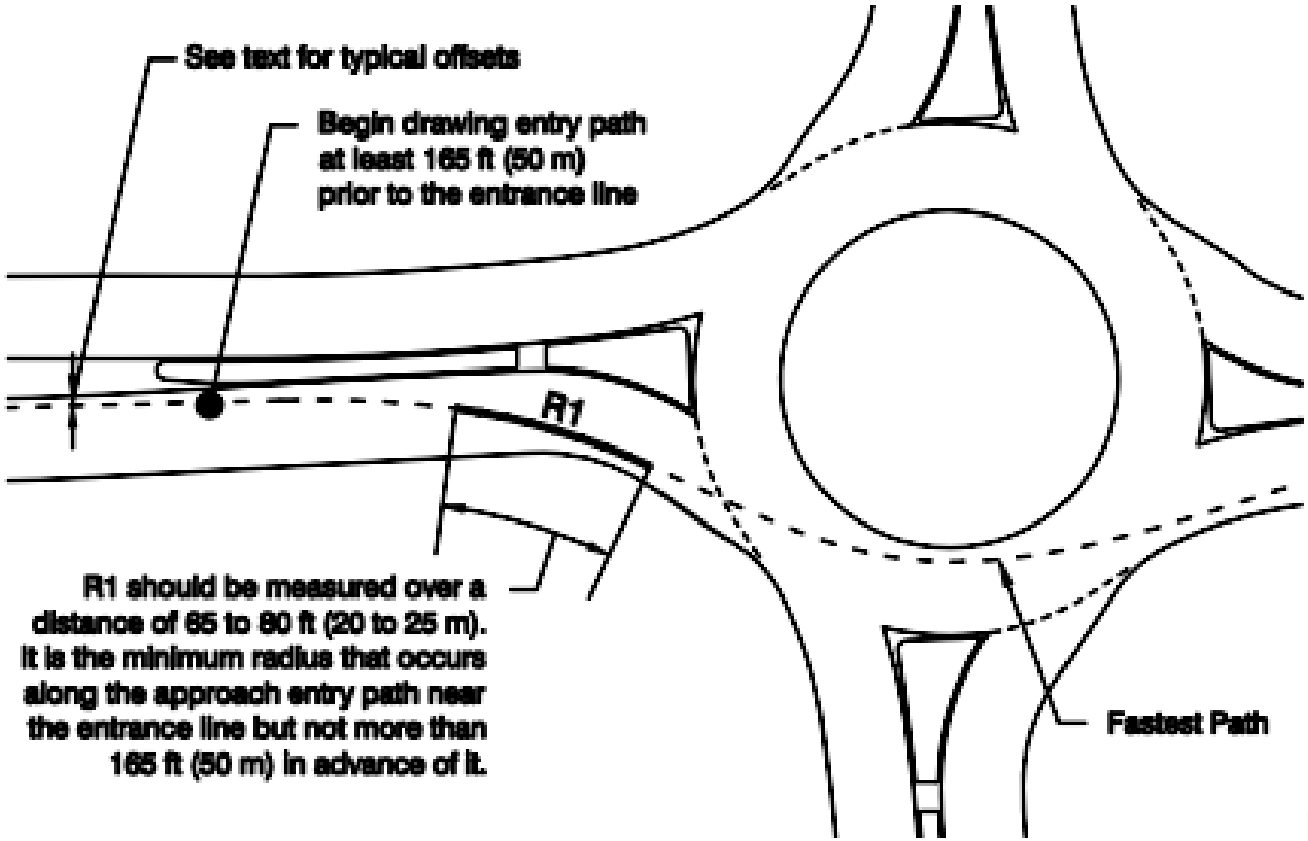


Exhibit 6-51

Design Documentation

Speeds Appropriate / Fastest Paths

...and how to determine the speeds from the radii.

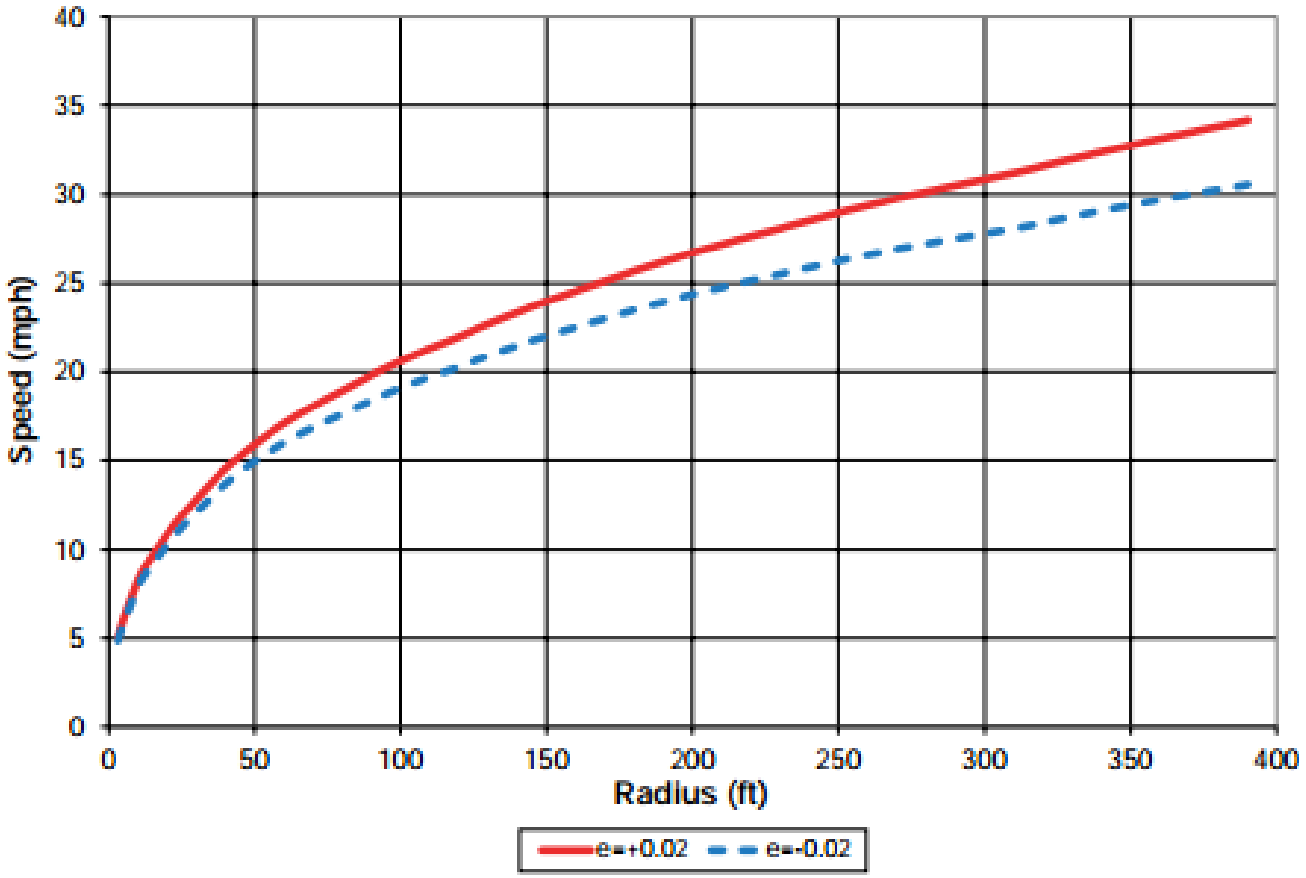


Exhibit 6-52

Eqn 6-1

Eqn 6-2

Design Documentation

Speeds Appropriate / Fastest Paths

Use Eqn 6-4 to check R_3 speed.

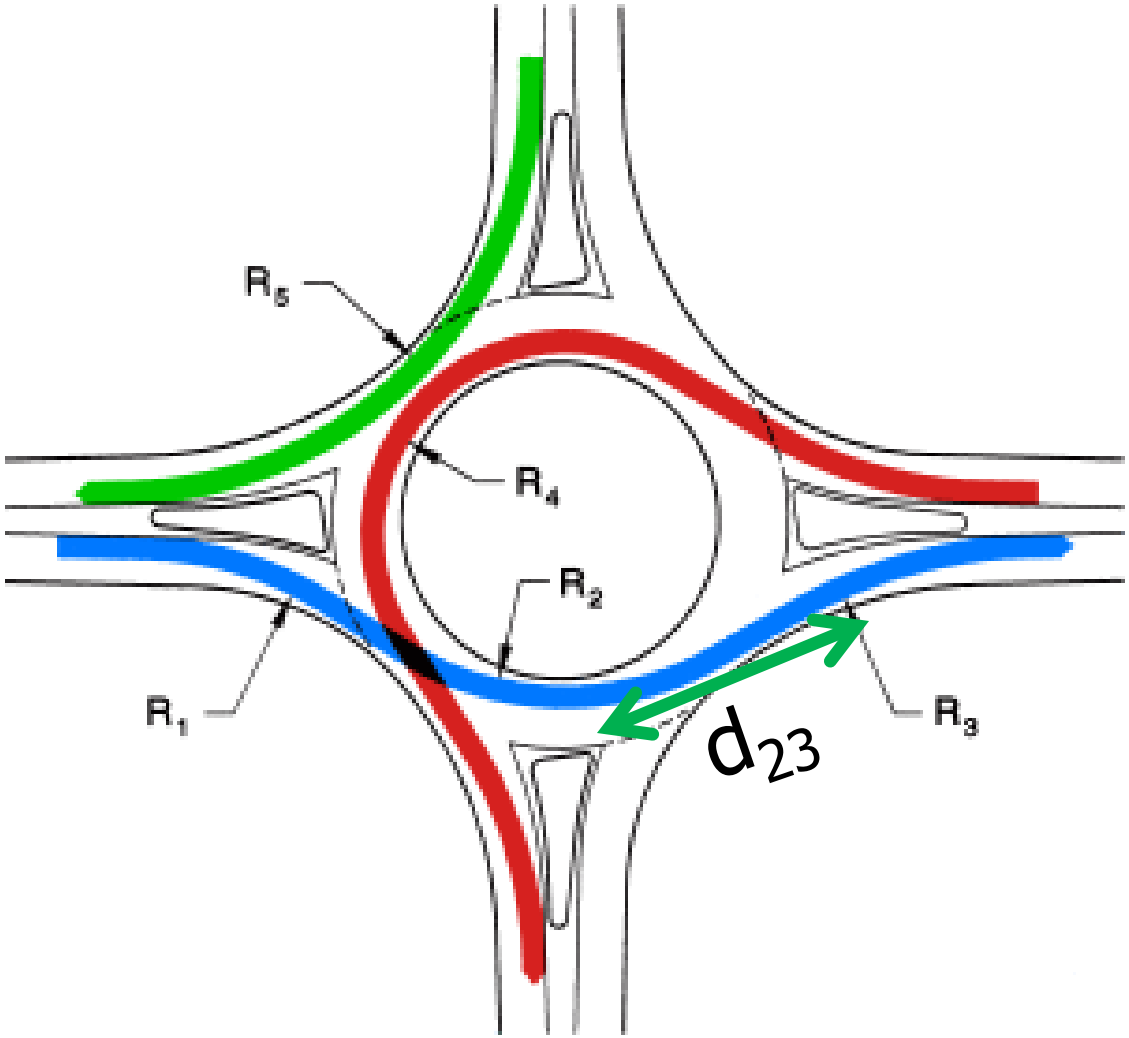
$$V_3 = \min\left\{\begin{array}{l} V_{3phase} \\ \dfrac{1}{1.47}\sqrt{(1.47V_2)^2 + 2a_{23}d_{23}} \end{array}\right\}$$

where

V_3 = exit speed, mph;
V_{3phase} = V_3 speed predicted based on path radius, mph;
V_2 = circulatory speed for through vehicles predicted based on path radius, mph;
a_{23} = acceleration between the midpoint of V_2 path and the point of interest along V_3 path = 6.9 ft/s^2; and
d_{23} = distance along the vehicle path between midpoint of V_2 path and point of interest along V_3 path, ft.

Design Documentation

Speeds Appropriate / Fastest Paths



Design Documentation

Speeds Appropriate / Fastest Paths

Roundabout Type	Recommended Fastest Path Speed
Mini Roundabout	20 mph
Single Lane Roundabout	25 mph
Multi Lane Roundabout	25 – 30 mph

- Speeds can exceed these recommendations
- Engineering judgment must be used
- Documentation must be provided

Design Documentation

Speed Differential / Consistency

Future IDM

- Desirable to have all speeds in roundabout within 10mph – 15mph of one another
- Refer to NCHRP 6.7.3.1
- Should be balanced with other roundabout needs. All variances should be explained in documentation

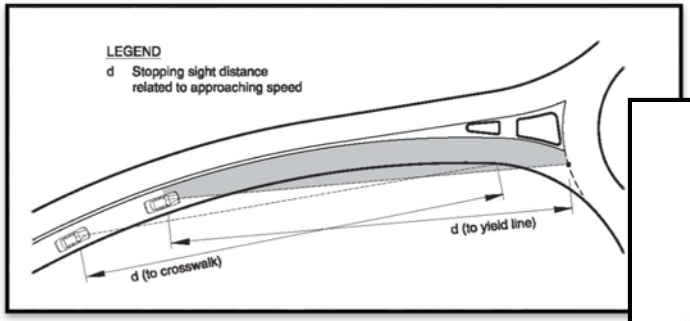
Design Documentation
Stopping Sight Distance

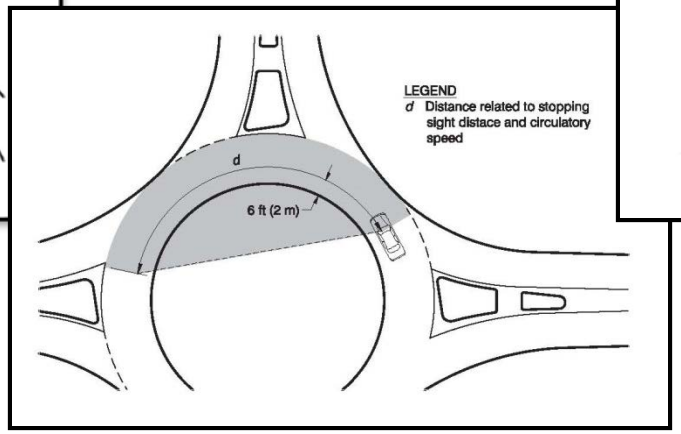
- All SSD calculations must be shown graphically
- Refer to NCHRP 6.7.3.1
- SSD is a level 1 criteria

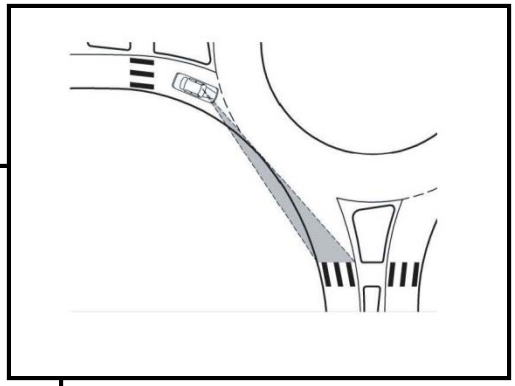
Design Documentation
Stopping Sight Distance

Three locations should be checked:

- Approach sight distance
- Sight distance on circulatory roadway
- Sight distance to crosswalk on exit







Design Documentation
Intersection Sight Distance

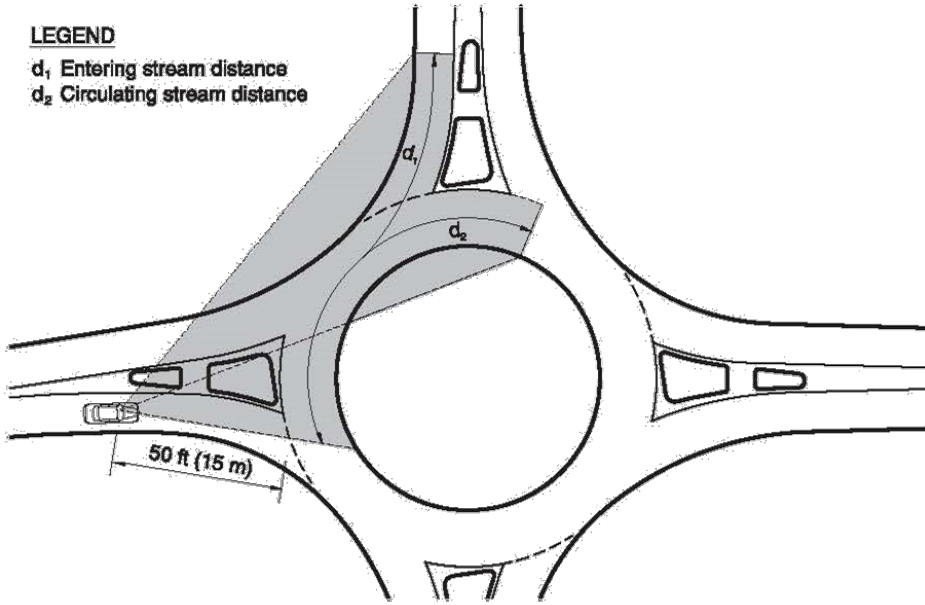
- All ISD calculations must be shown graphically
- Refer to NCHRP 6.7.3.2
- ISD is soon to be a level 1 criteria
- Too much ISD can increase roundabout speeds
- Use equations found in NCHRP 672

Design Documentation

Intersection Sight Distance – Revisions to IDM

Future IDM

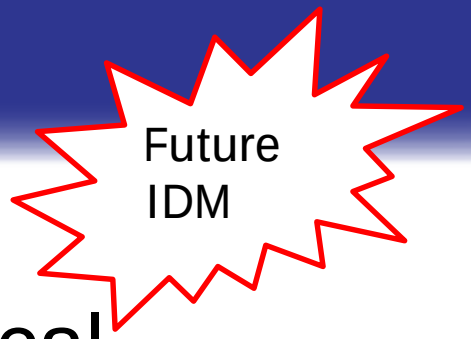
- Eye location set 50’ from yield line
- Use NCHRP 672 equation 6-6 and 6-7 with t_c = 5.0s
- d_1 can be minimized to 50’ behind yield line (documentation required)



Eqn 6-6 ⇨ $d_1=(1.468)(V_{major,\ entering})(t_c)$

Eqn 6-7 ⇨ $d_2=(1.468)(V_{major,\ circulating})(t_c)$

Design Documentation
Allowable Landscaping Areas



- Include an overlay of all graphical checks of ISD and SSD on a single sheet
- Overlays will reveal areas where landscaping height is and is not restricted
- Must perform checks even if landscaping is not part of original plans

Design Documentation
Allowable Landscaping Areas

- Splitter Island maximum landscaping height will be 1.5’ from top of curb
- Refer to NCHRP 672 Chapter 9 for additional guidance

Design Documentation
Lighting Design

FHWA Roundabout Guide:

"For a roundabout to operate satisfactorily, a driver must be able to enter the roundabout, move through the circulating traffic, and separate from the circulating stream in a safe and efficient manner. To accomplish this, a driver must be able to perceive the general layout and operation of the intersection in time to make the appropriate maneuvers. Adequate lighting should therefore be provided at all roundabouts."

Design Documentation
Lighting Design

- Present guidance and resources
  - NCHRP 672, Chapter 8
  - IESNA Publication DG-19-08
  - AASHTO
  - Proprietary methods and vendor assistance

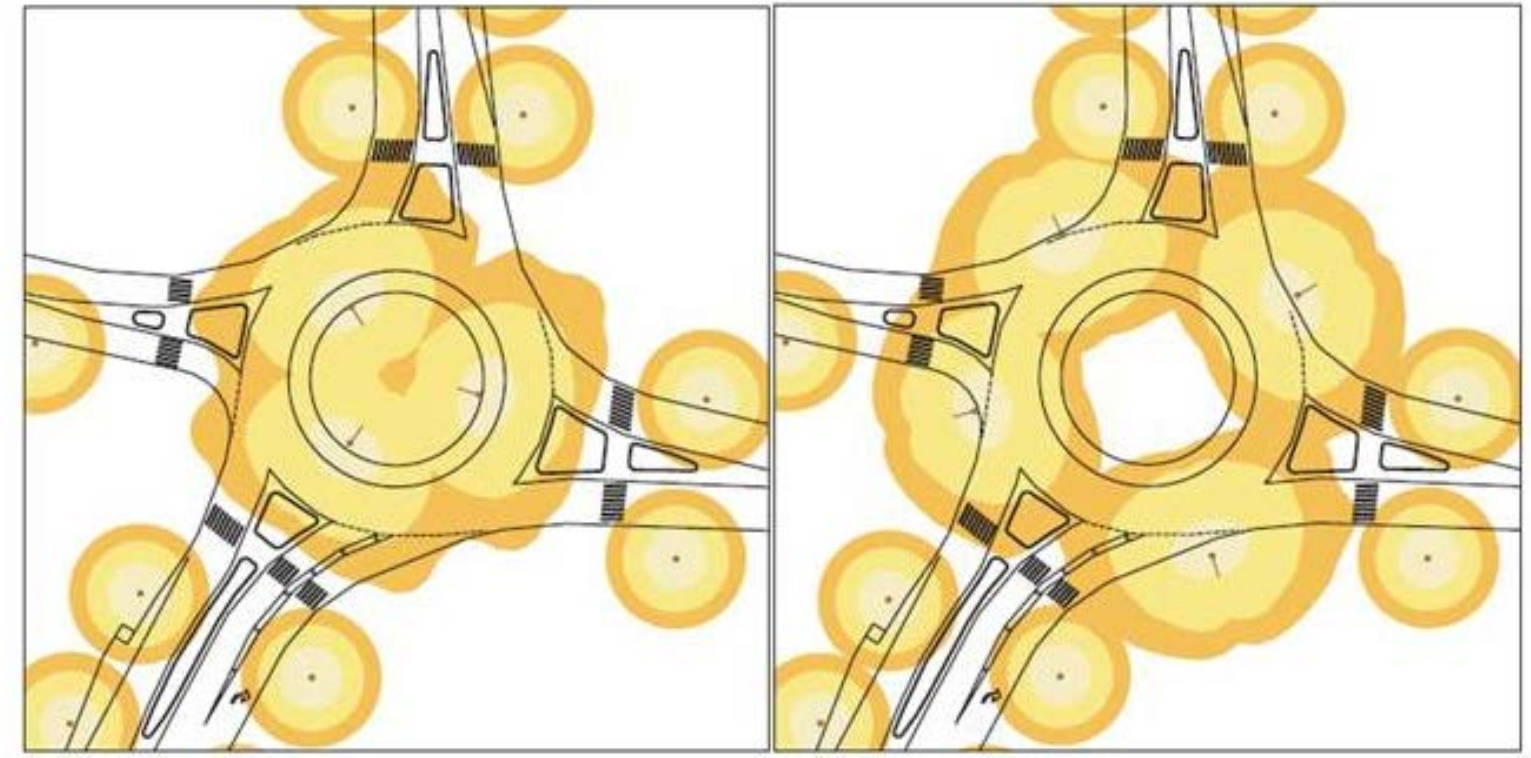
Design Documentation

Lighting Design

- Several studies have been completed to determine the best lighting practices at roundabouts.
  - Approaches
  - Circulatory Roadway
  - Exits
- Light placement in advance of pedestrian facilities is critical – try not to “backlight” pedestrians
- Pavement markings, signs, and lighting designs go hand-in-hand

Design Documentation
Lighting Design

Light poles can be placed in central island if necessary but should not be placed in splitter islands



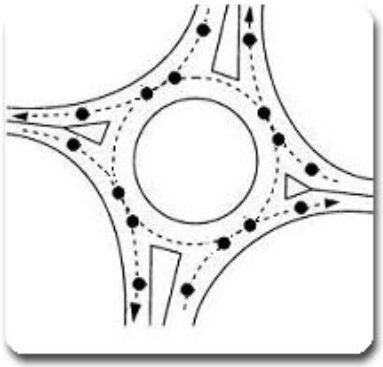
Central Illumination Design

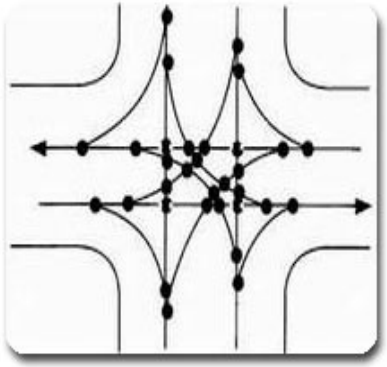
Perimeter Illumination Design

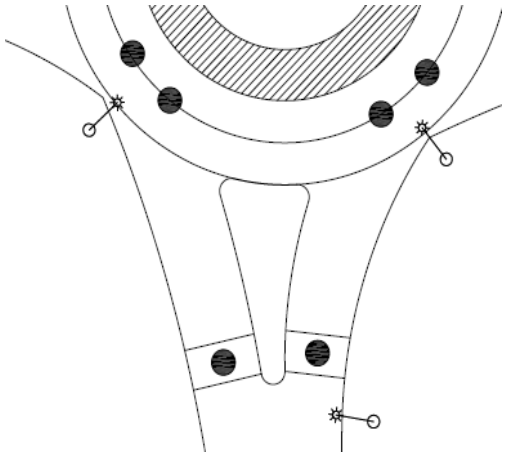
Design Documentation

Lighting Design – Conflict Points and Luminaire Placement

- Important locations
  - Crosswalks
  - 45°, 135°, 225°, 315° quadrant points
- Consider clear zone
- Evaluate arm lengths

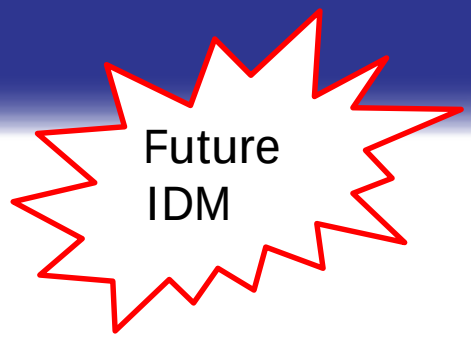






Design Documentation

Lighting Design



- All roundabouts need to be lit
- Place one light in advance of each approach crosswalk
- Additional lighting at roundabouts should be considered to better illuminate the roundabouts and eliminate dark spots
- Light pollution to neighboring residents can be a concern
- Center island landscaping can incorporate uplighting for additional visibility

Roundabout Design

Geometry

- Roundabout geometry plays a major role in the capacity and safety of the roundabout
- Geometry of roundabout design needs to match geometry in capacity analysis
- If geometry is different than engineer's report, designer should re-run capacity analysis

Roundabout Design

Inscribed Circle Diameter

Roundabout Design

Inscribed Circle Diameter

Roundabout Type	Low End	High End
Single Lane	90’	180’
Two Lane	150’	220’
Three Lane	200’	300’

- Refer to NCHRP 6.3.1
- Exhibit 6-9 provides better detail of inscribed diameters
- Document rationale if larger or smaller sizes are used

Roundabout Design
Approach Alignment

- Right offset should be avoided.
- Left offset is preferred because it typically improves deflection
- Justification of right offset should be provided with documentation
- Refer to NCHRP 6.3.2

Entry Alignment

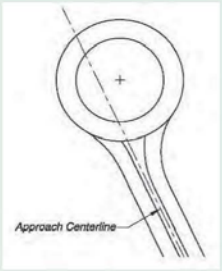
Question

Should the approach alignment run through the center of the inscribed circle? Or is it acceptable to offset the approach centerline to one side?

Design Principle

The alignment does not have to pass through the center of the roundabout; however, it has a primary effect on the entry/exit design. The optimal alignment allows for an entry design that provides adequate deflection and speed control while also providing appropriate view angles to drivers and balancing property impacts/costs.

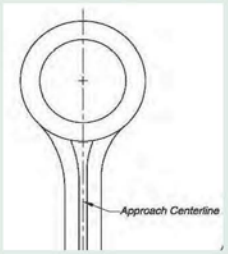
Alternative 1: Offset Alignment to the Left of Center



ADVANTAGES:
- Allows for increased deflection
- Beneficial for accommodating large trucks with small inscribed circle diameter—allows for larger entry radius while maintaining deflection and speed control
- May reduce impacts to right-side of roadway

TRADE-OFFS
- Increased exit radius or tangential exit reduces control of exit speeds and acceleration through crosswalk area
- May create greater impacts to the left side of the roadway

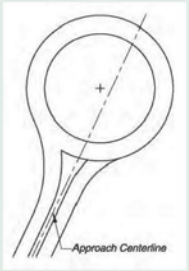
Alternative 2: Alignment through Center of Roundabout



ADVANTAGES:
- Reduces amount of alignment changes along the approach roadway to keep impacts more localized to intersection
- Allows for some exit curvature to encourage drivers to maintain slower speeds through the exit

TRADE-OFFS
- Increased exit radius reduces control of exit speeds/acceleration through crosswalk area
- May require a slightly larger inscribed circle diameter (compared to offset-left design) to provide the same level of speed control

Alternative 3: Alignment to Right of Center



ADVANTAGES:
- Could be used for large inscribed circle diameter roundabouts where speed control objectives can still be met
- Although not commonly used, this strategy may be appropriate in some instances (provided that speed objectives are met) to minimize impacts, improve view angles, etc.

TRADE-OFFS
- Often more difficult to achieve speed control objectives, particularly at small diameter roundabouts
- Increases the amount of exit curvature that must be negotiated

Roundabout Design
Approach Alignment

Why is left offset preferred?

- Desired deflection is easier to achieve
- Can utilize a smaller circle without reducing deflection
- Results in slower entry speeds

Roundabout Design

Circulatory Roadway Width

Roundabout Design

Circulatory Roadway Width

Roundabout Type	Low End	High End
Single Lane	16’	20’
Two Lane	28’	32’
Three Lane	42’	48’

- Refer to NCHRP 6.4.3 and 6.5.3
- “Rule of Thumb” is that circulatory roadway is 100% to 120% of entry width

Roundabout Design

Approach Radii

Roundabout Design

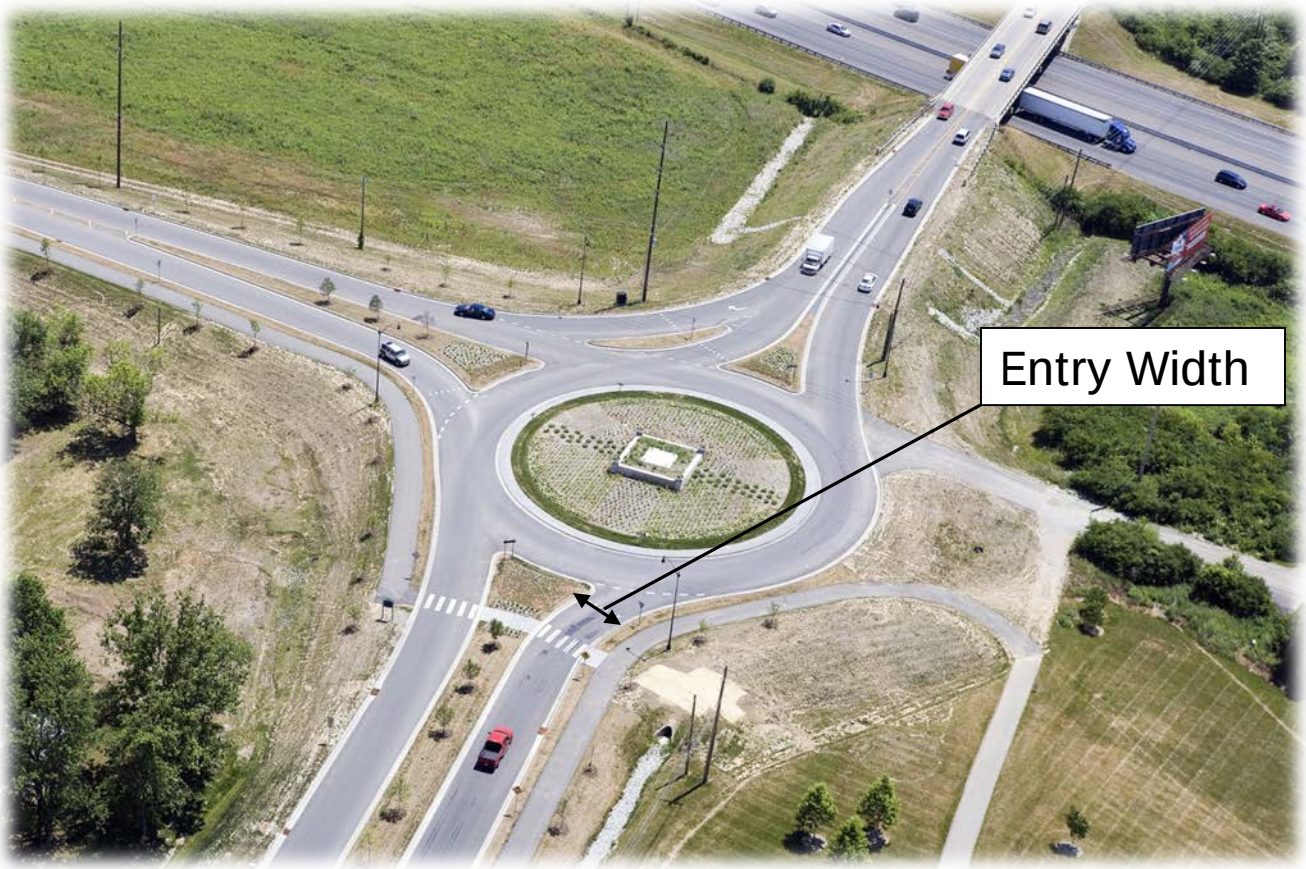
Approach Radii

Roundabout Type	Low End	High End
Single Lane	50’	100’
Multi-Lane	65’	120’

- Design should match the geometry used in the capacity analysis
- A wide range may be appropriate depending upon the components of the design
- Refer to NCHRP 6.4.5 and 6.5.4

Roundabout Design

Entry Width



Roundabout Design

Entry Width

Roundabout Type	Low End	High End
Single Lane	14’	18’
Two Lane	24’	30’
Three Lane	36’	45’

- Measured perpendicular to left and right curb lines
- Refer to NCHRP 6.4.2 and 6.5.2

Roundabout Design

Exit Radii

Roundabout Design

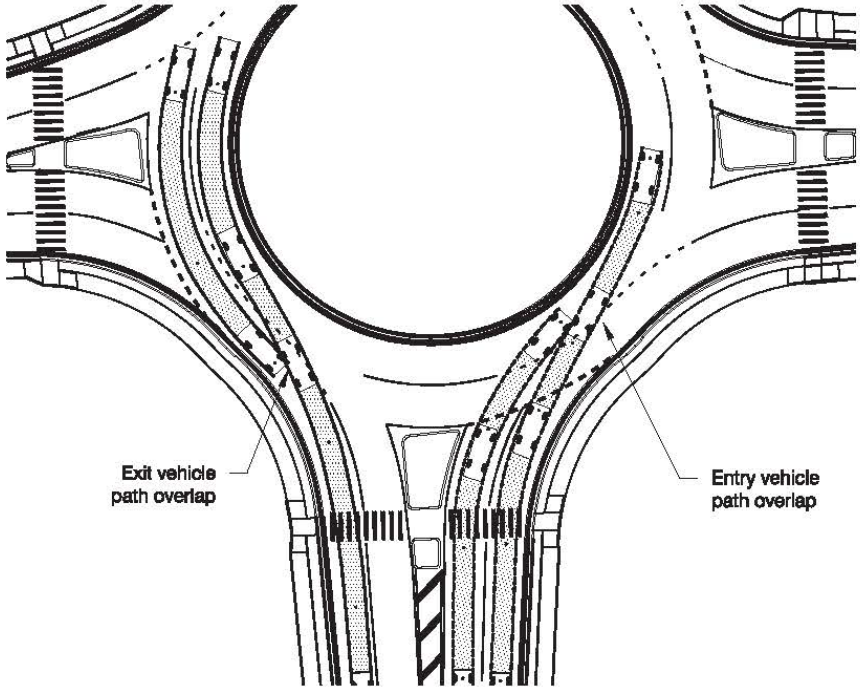
Exit Radii

- Typically 100’ to 800’
- 300’ to 600’ is desirable
- Refer to NCHRP 6.4.6 and 6.5.6
- Exit radii as small as 50’ can be used if necessary to control speeds at crosswalk
- Smaller exit radii can affect natural flow of traffic through roundabout and reduce capacity

Roundabout Design

Entry Path or Exit Overlap

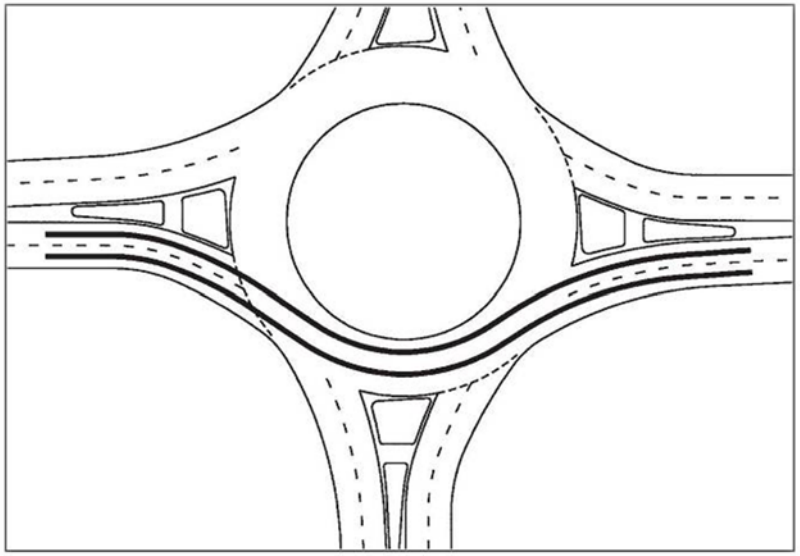
- Only affects multi-lane roundabouts
- Refer to NCHRP 6.2.3
- Figure 51-22NN in current IDM illustrates how to avoid overlap



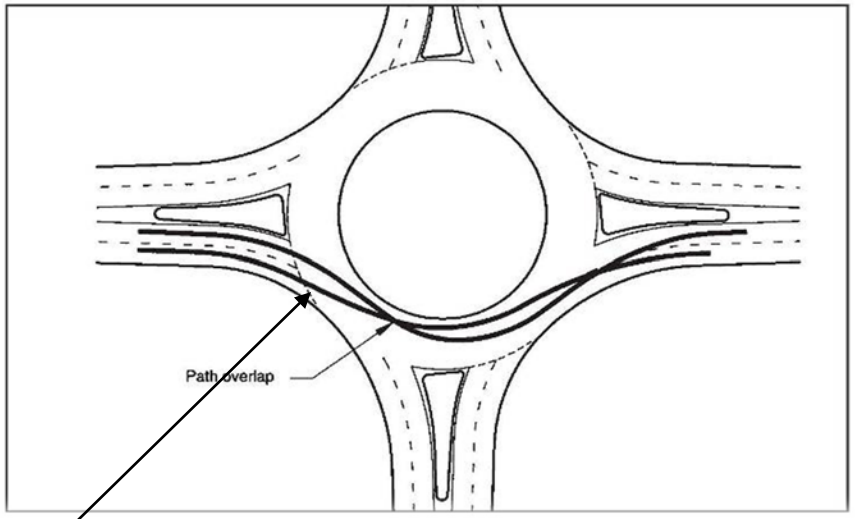
Roundabout Design

Entry Path or Exit Overlap

Desired Path of Vehicles



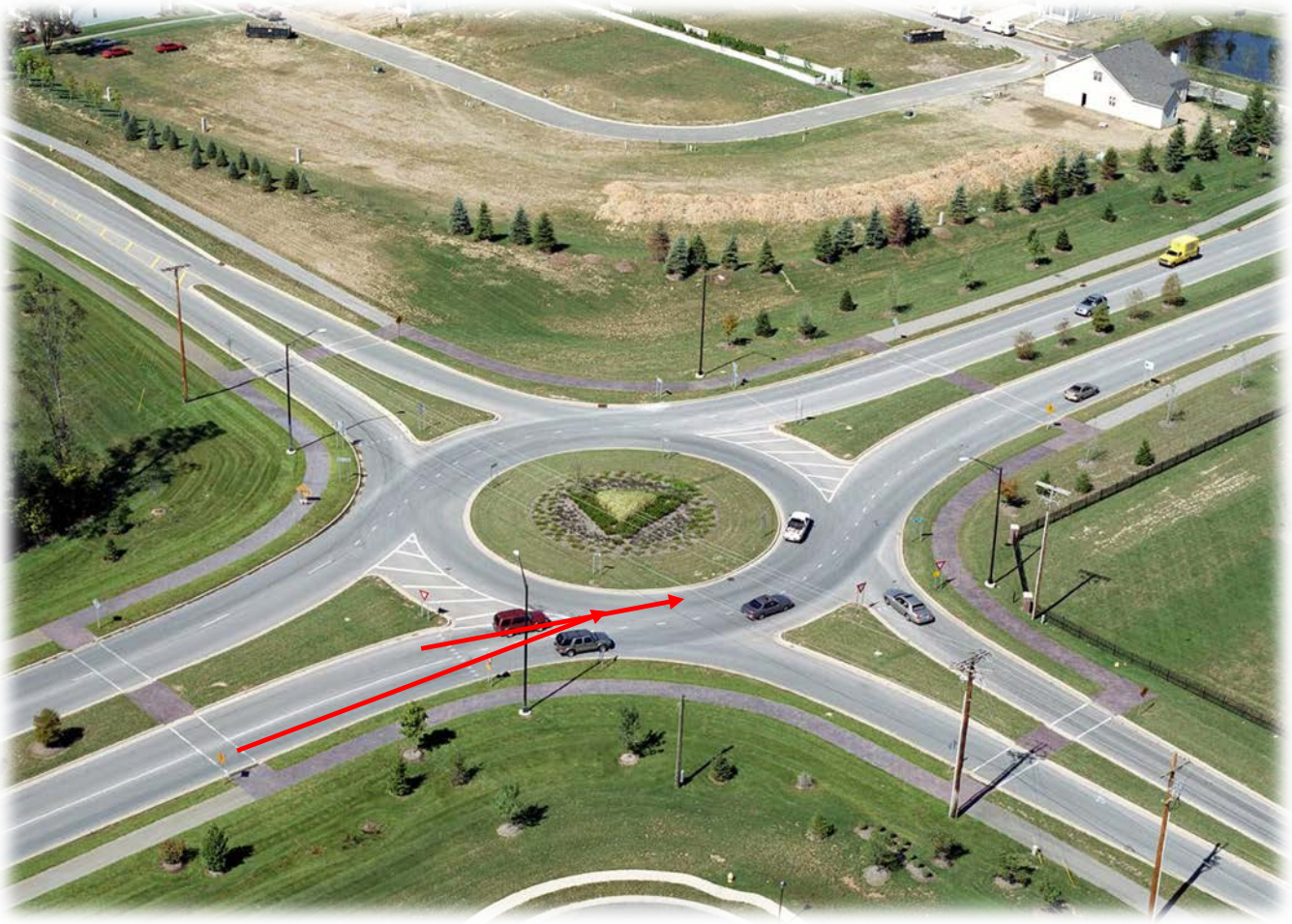
Entry Path Overlap



Speed & Trajectory of vehicle at yield point determines natural path

Striping and proper geometric design is crucial to achieving proper lane use!

Case Study - Entry Path Overlap



Roundabout Design

Truck Apron

Roundabout Design

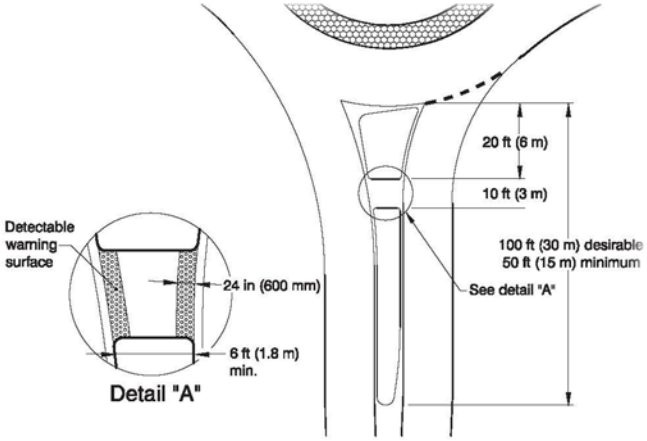
Truck Apron Width

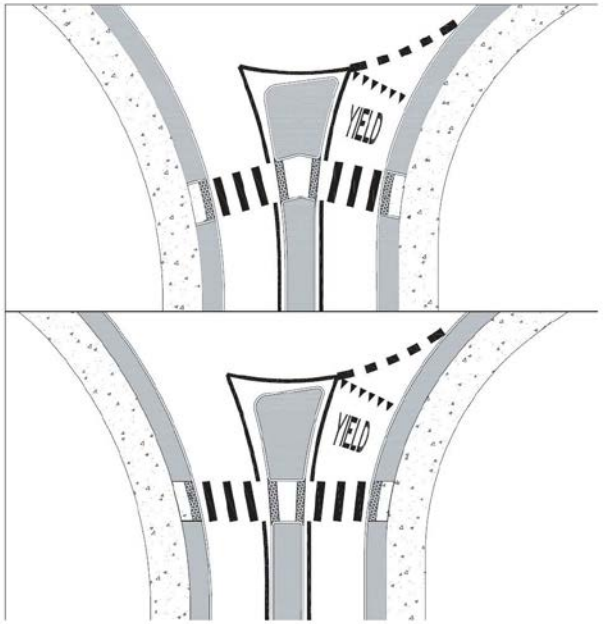
- Truck apron allows large vehicles to track to the inside of the roundabout
- Minimum effective/constructible width is 3', minimum width of 5' is desirable
- No maximum width – based on turning templates
- Refer to NCHRP 6.4.7.1 and 6.8.7.4
- Documentation for proper design vehicle and illustrating adequate width should be included with design submittals

Roundabout Design

Pedestrian Crossing

- Crosswalk should be placed 20’-40’ behind Yield Line (one to two car lengths)
- Refer to NCHRP 6.4.1 and 6.8.1.2
- Ample length and width of splitter island should be designed to provide a safe refuge for pedestrians
- Placement should coincide with a vehicle’s slowest speed on approach
- Pay attention to cross-slope





Roundabout Design

Pavement Markings & Signs

- Pavement markings and signs are critical to the function of roundabouts
- Pavement marking schematics should be submitted with Stage 1 plans to illustrate design intent
- Pavement markings should be designed in accordance with MUTCD 3C and NCHRP 7.3
- Signs should be designed in accordance with MUTCD 2B.43-45 and NCHRP 7.4

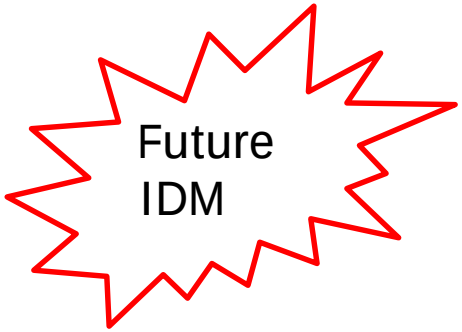
Roundabout Design

Entry Grade Profile

Roundabout Design

Entry Grade Profile

- Entry grade profile should be leveled out so as not to exceed 3%
- Entry grade profile is defined as the area approximately two car lengths from the outer edge of the circle
- Refer to NCHRP 6.8.7.5



Roundabout Design

Drainage Structures

- Avoid drainage structures within circulatory roadway
- Desirable location is between circulatory roadway and curb ramps
- Primary reason for concern is maintenance difficulties
- Refer to NCHRP 6.8.7.6
- In some situations, this can not be avoided to meet spread/encroachment requirements

Design Plans

- Spot elevations and/or grading plans should be clear and concise
- Sign types and locations should be clearly defined
- Specialty pavement markings must be clearly detailed

Design Plans

- Radii should be clearly labeled
- For early plan submittals – Provide the reviewer ample information to identify the critical elements (ICD, Approach & Exit Radii, etc.)
- For Stage 3 plans - Can a contractor build the roundabout with the information provided?

Future Policy Updates

- Indiana Design Manual Updates – Upcoming!
  - Significantly reduced
  - Largely relies on NCHRP 672
  - Incorporated into intersections chapter 305
  - May be organized per checklist

Future Policy Updates

- Checklist modifications
- All roundabouts will now be considered 4R
- Adding lane drop taper requirements
- High speed approach detail modifications

Future Policy Updates

- Clear zone definition
  - Curb offset + 4’ for interior
  - Curb offset + 6’ for perimeter
  - Clear zone transition zone on approach
- Pedestrian signal recommendations

Common Questions

- How important is public education?
- How do you maintain traffic during construction?
- What about visually impaired pedestrians?
- Are roundabouts safe on high speed facilities?
- What about bicyclists?

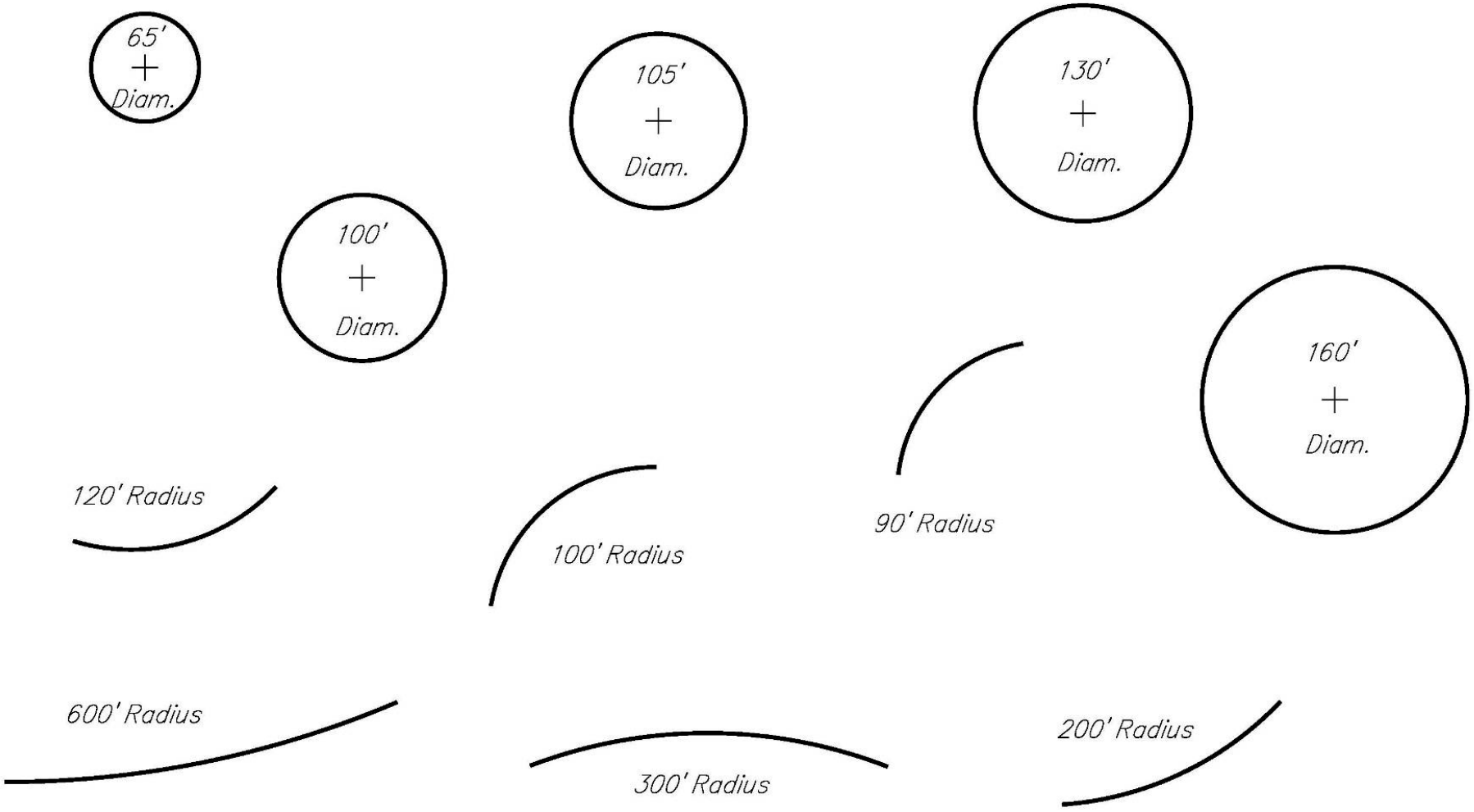
Single Lane Roundabout Layout

Single Lane Roundabout Layout

Getting Started

- 5 step process with a foundation of designing pavement marking alignments
- Multiple iterations of these 5 steps will need to be completed to achieve the optimum geometric design
- Curbs and edges of pavement are derived by the pavement markings in accordance with the FHWA Roundabout Guide.

Disclaimer: *There are many approaches to achieve a sound geometric roundabout design. This approach is just one relatively simple method we have found to work.*



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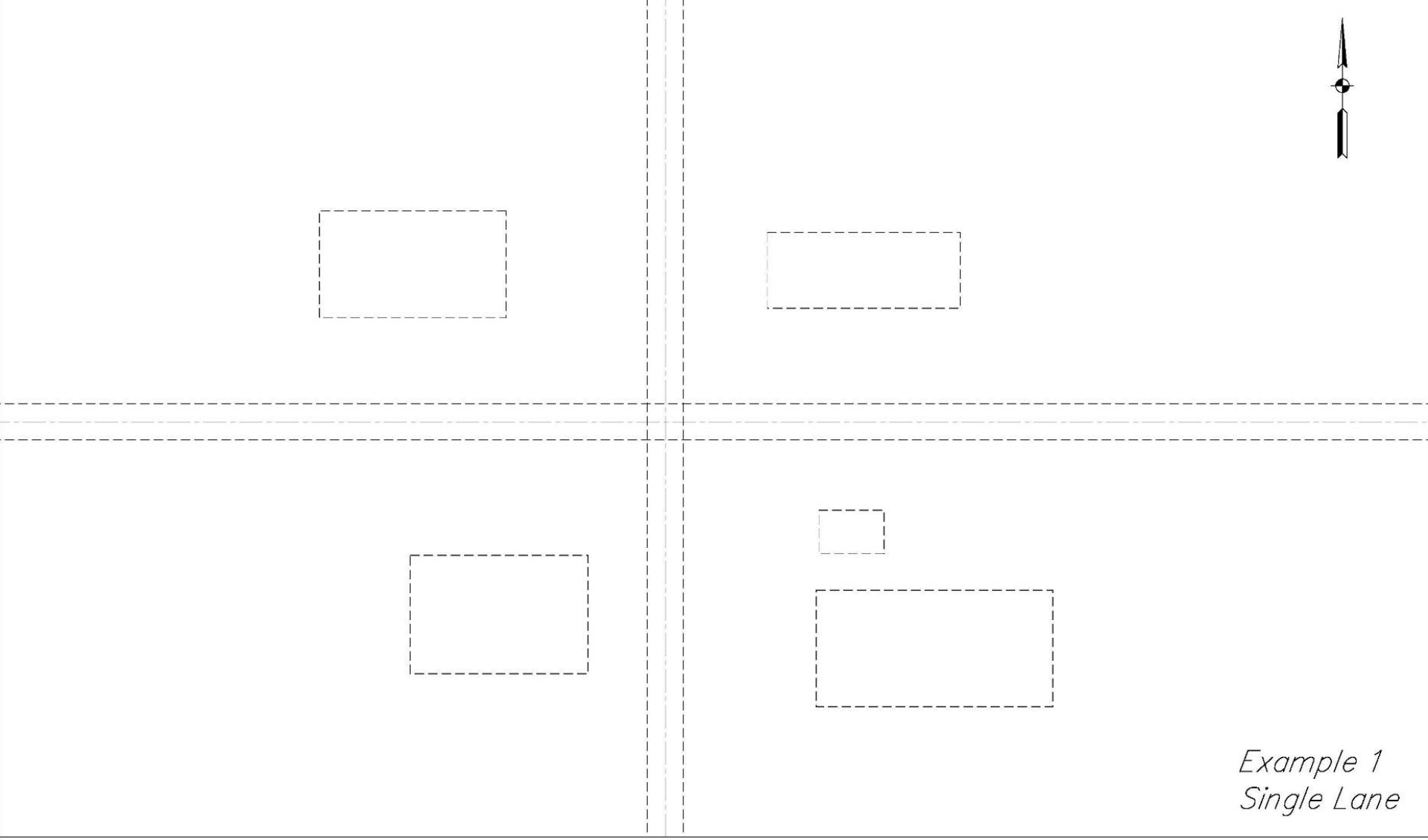

Example 1
Single Lane

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Single Lane Roundabout Layout

Geometric Basics

- Inscribed diameter
  - Typically start with 130’ and adjust based on existing conditions
  - Dependent on your design vehicle
- Circulatory roadway width
  - Dependent on your design vehicle
  - Typically start with 15’-16’ for a single lane roundabout
- Truck apron width
  - Dependent on your design vehicle tracking
  - Typically start with 5’

Single Lane Roundabout Layout

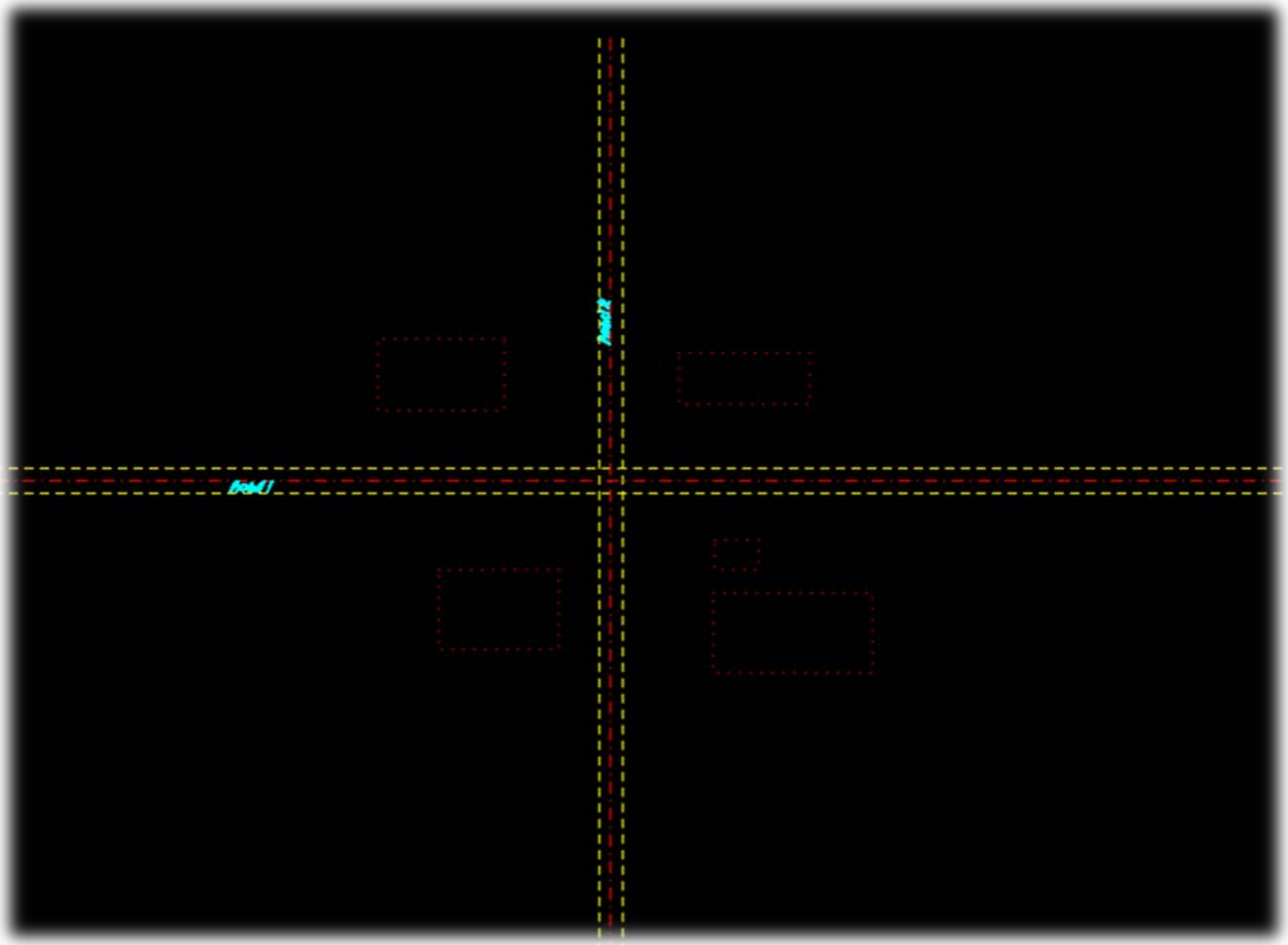
Geometric Basics

- Approach Radius
  - Typically start with 100’
  - Affects roundabout capacity and speeds
- Exit Radius
  - Typically start with 600’
  - Affects roundabout capacity and speeds

Single Lane Roundabout Layout

Situation

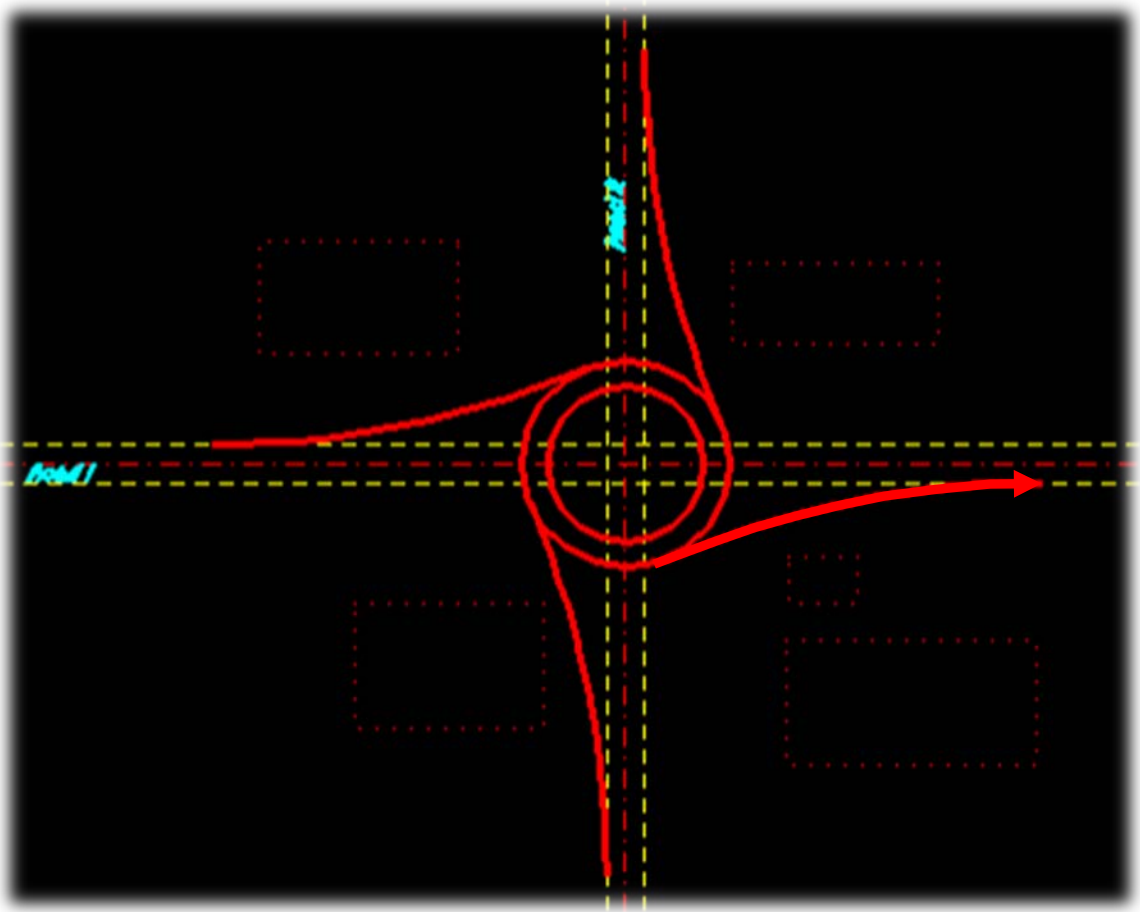
- Simple 90 degree intersection
- Both roadways are 2 lane roads



Single Lane Roundabout Layout

Step 1

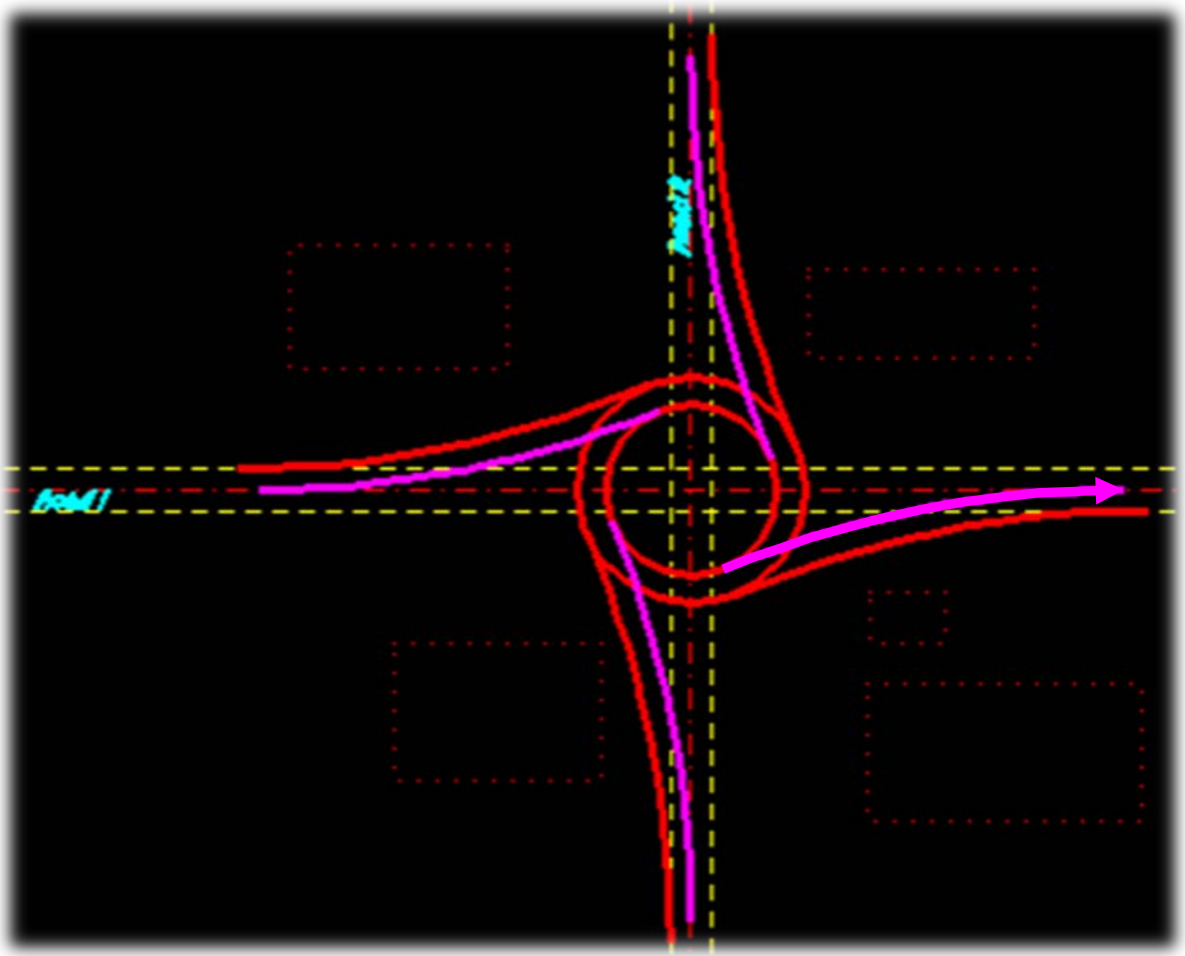
- Draw center circle
- Offset for circulatory roadway width
- Draw exits



Single Lane Roundabout Layout

Step 2

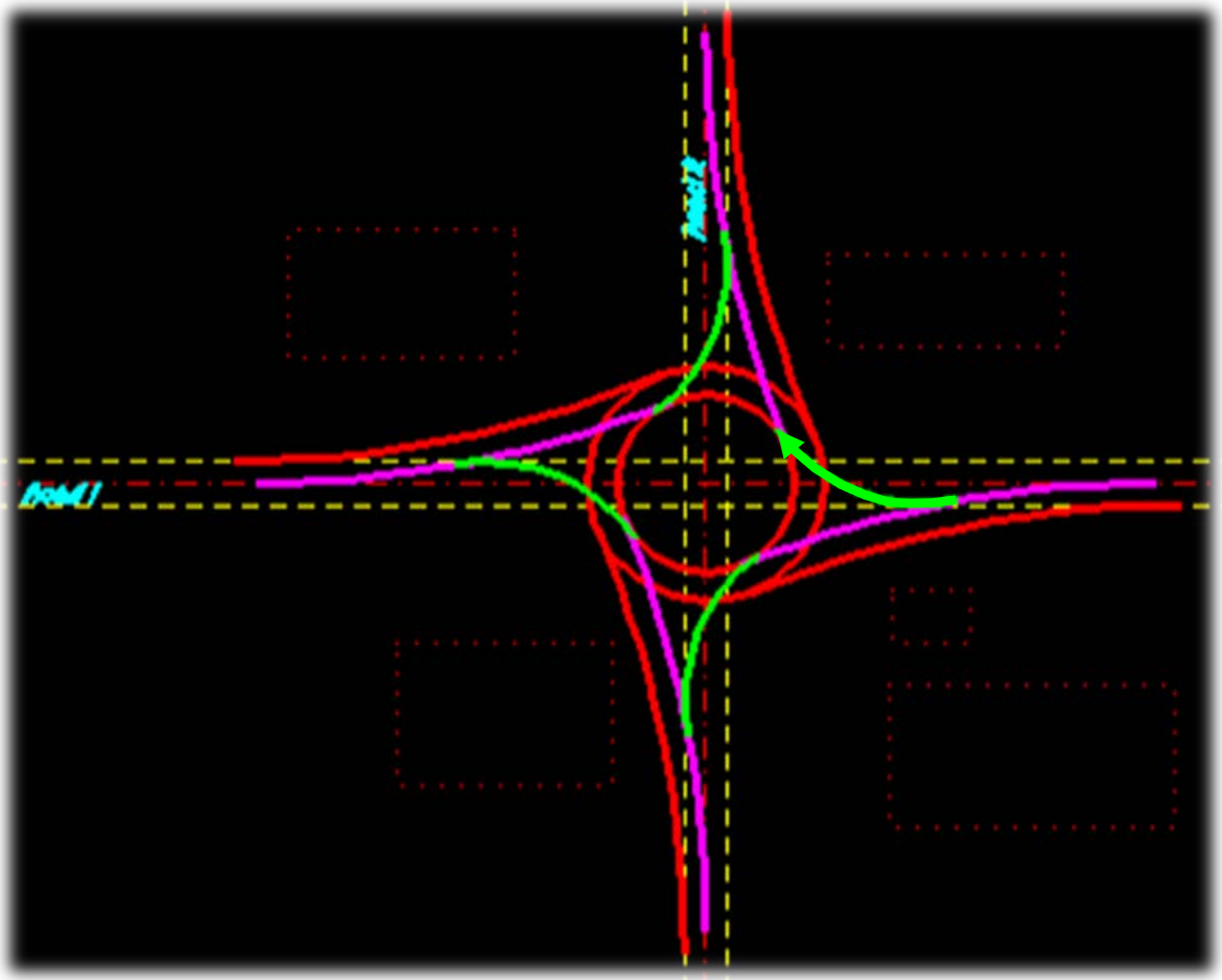
Fillet centerline to inside of circulatory roadway for exits



Single Lane Roundabout Layout

Step 3

Fillet inside of exit lane with inside circle to create inside approach lane



Single Lane Roundabout Layout

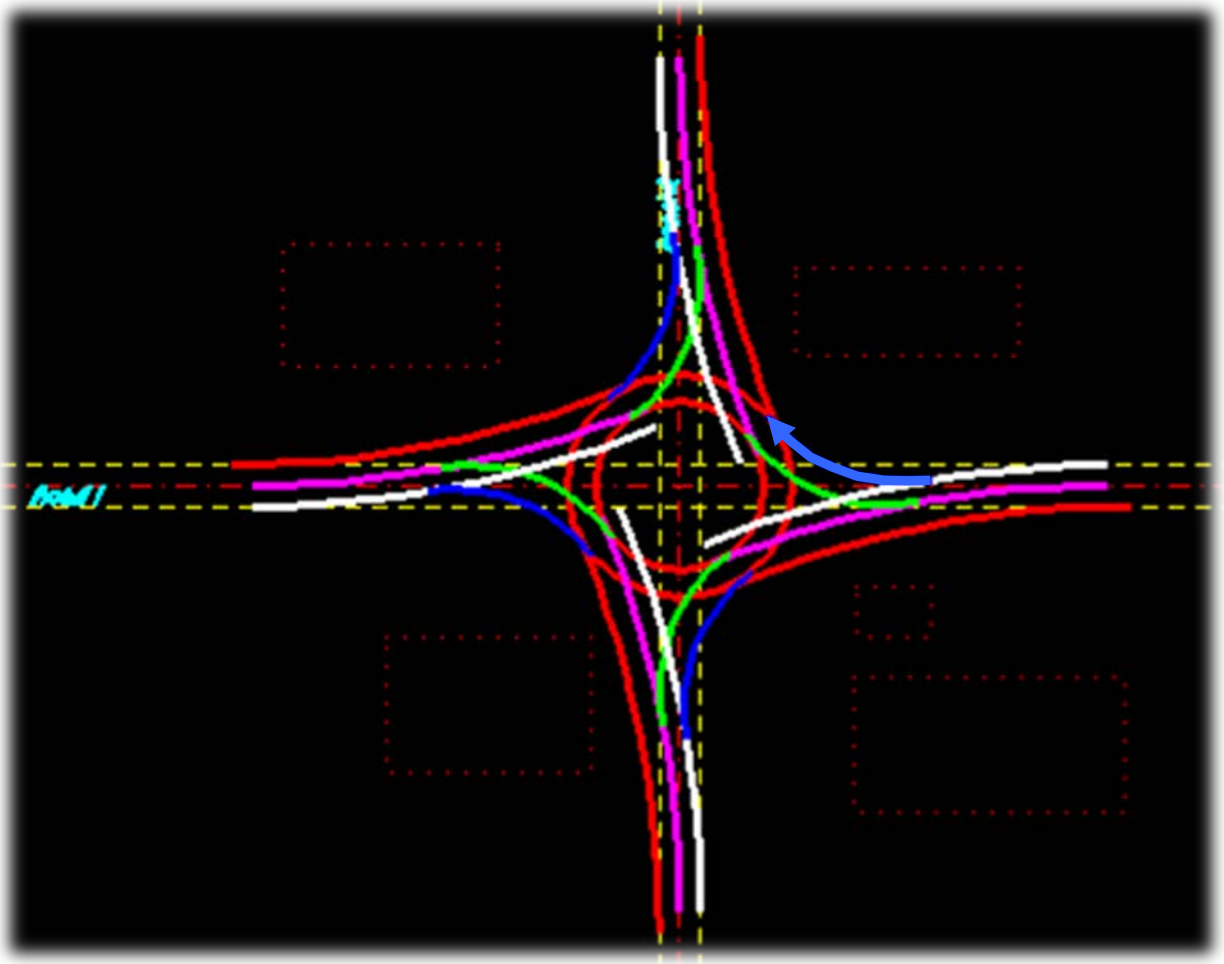
Step 4

Offset inside of exit lane to match approaching lane width

Single Lane Roundabout Layout

Step 5

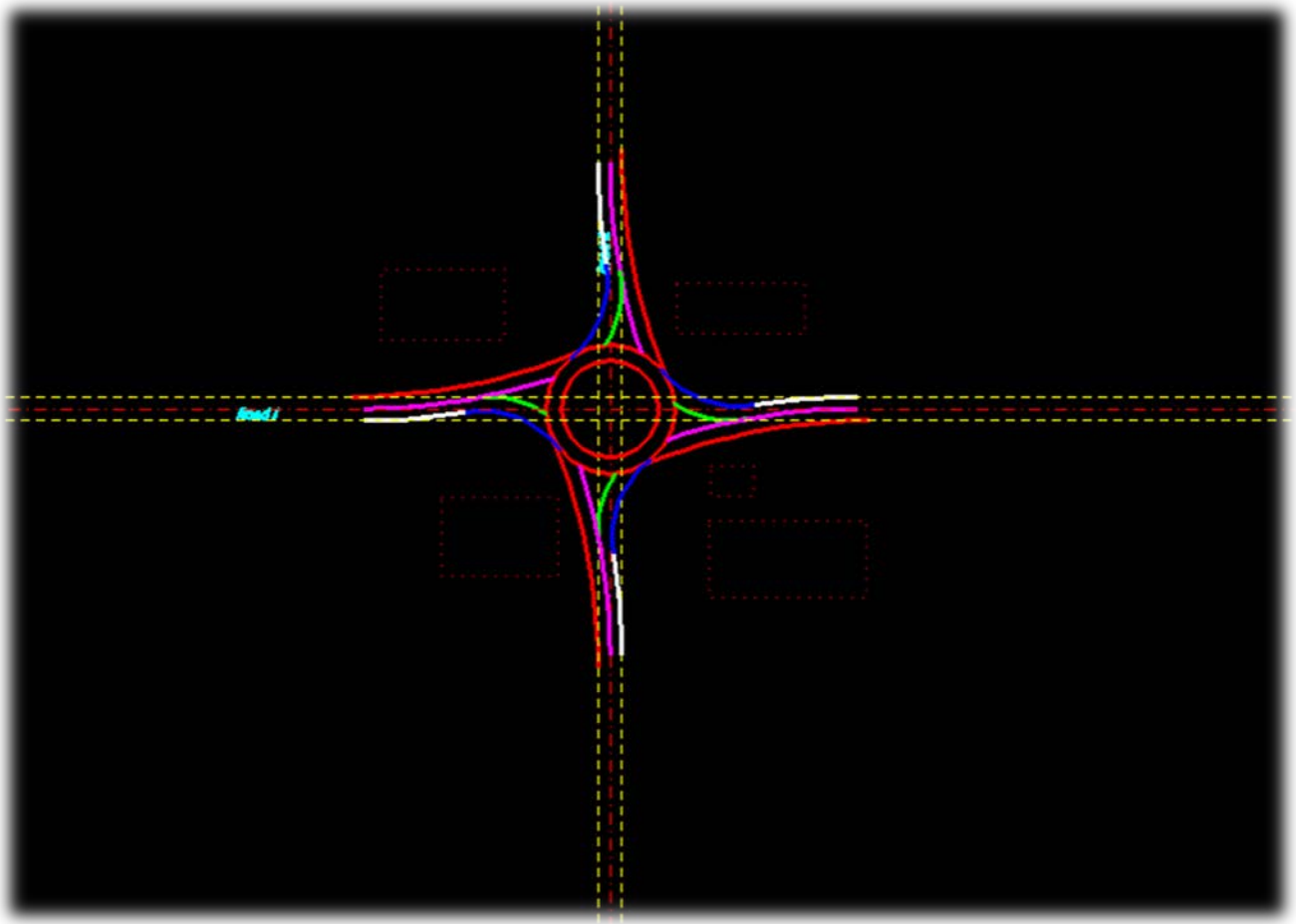
Fillet with outside edge of circulatory roadway



Single Lane Roundabout Layout

Step 6

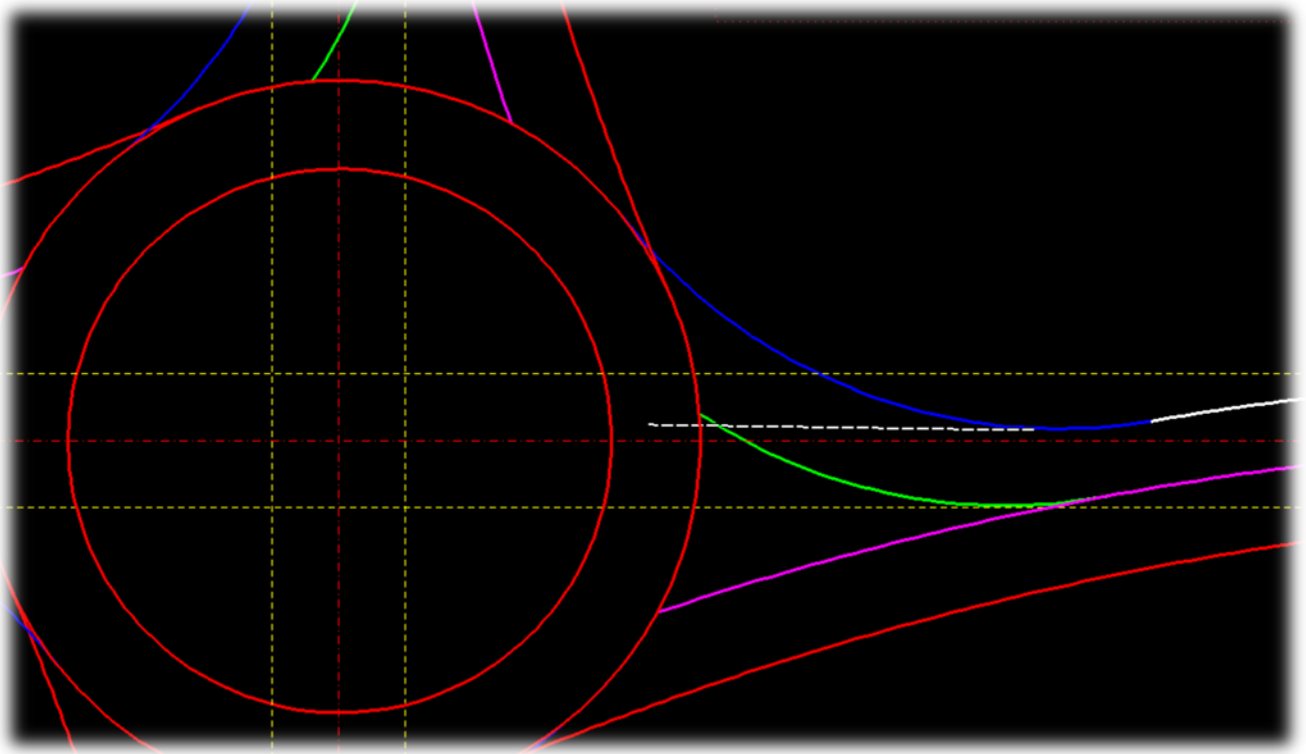
Trim & review your geometrics

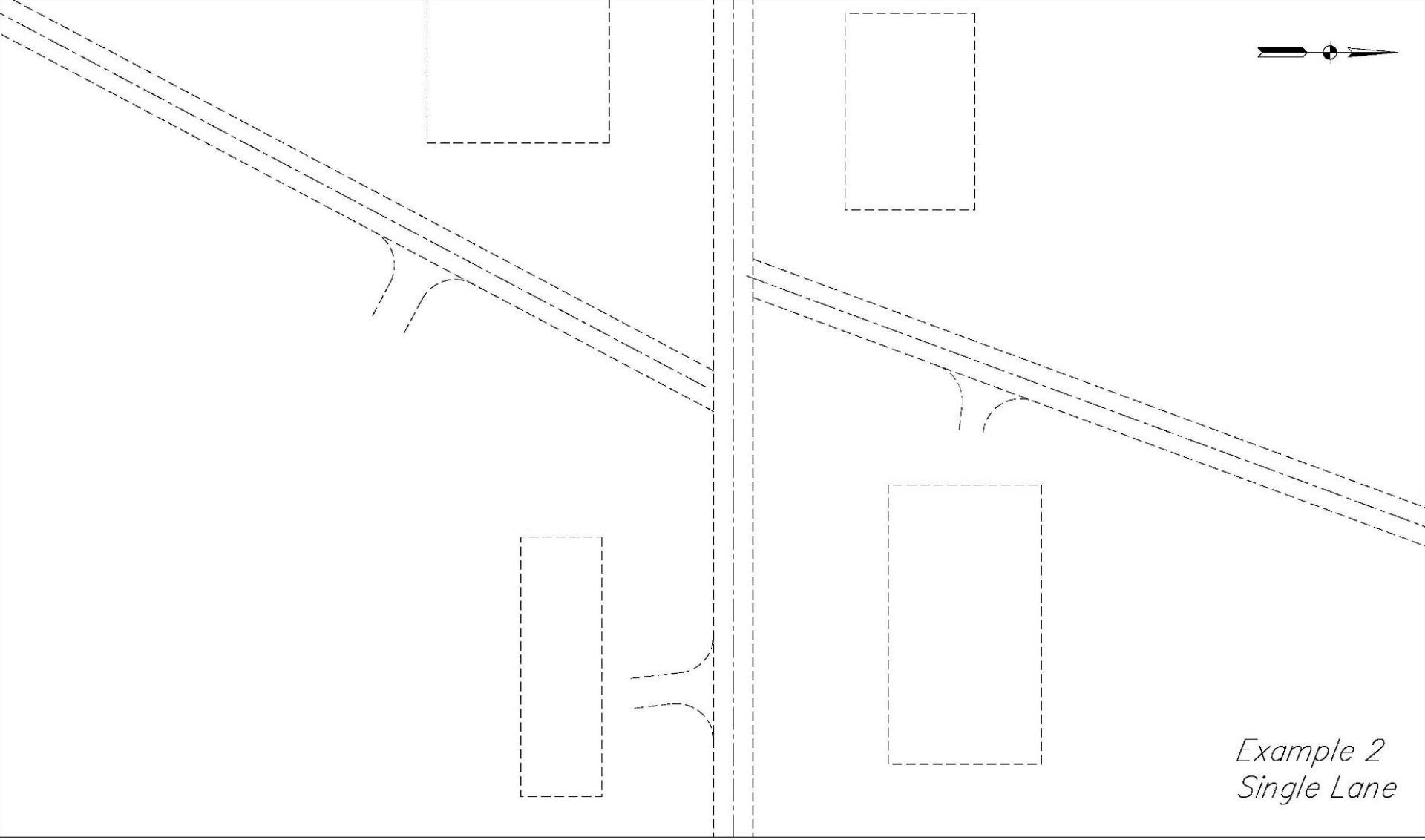


Single Lane Roundabout Layout

Deflection Check

Tangent to outside edge of approach should line up close to point where inside edge of approach intersects circulatory roadway





Example 2
Single Lane

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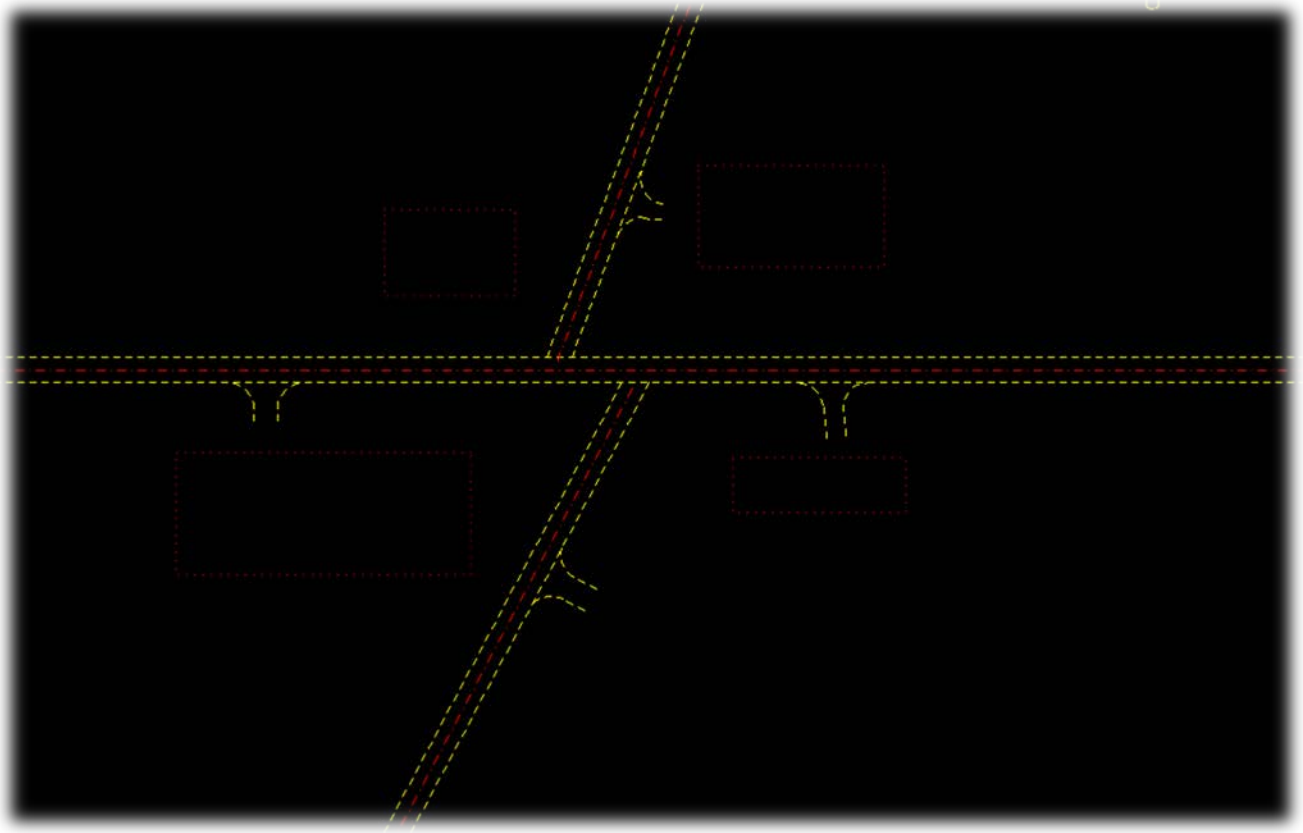
Single Lane Roundabout Layout

Situation 2

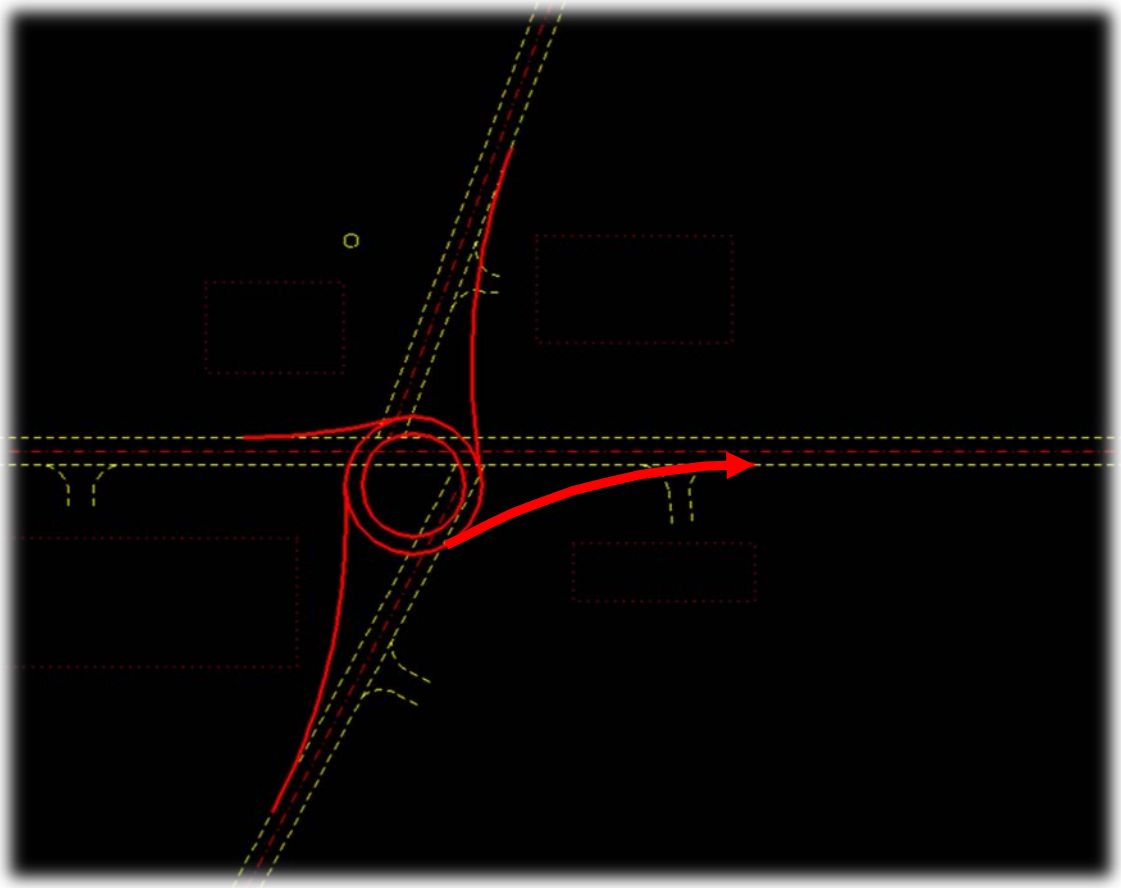
- Offset intersection
- Higher speed on east-west road



Single Lane Roundabout Layout

Step 1

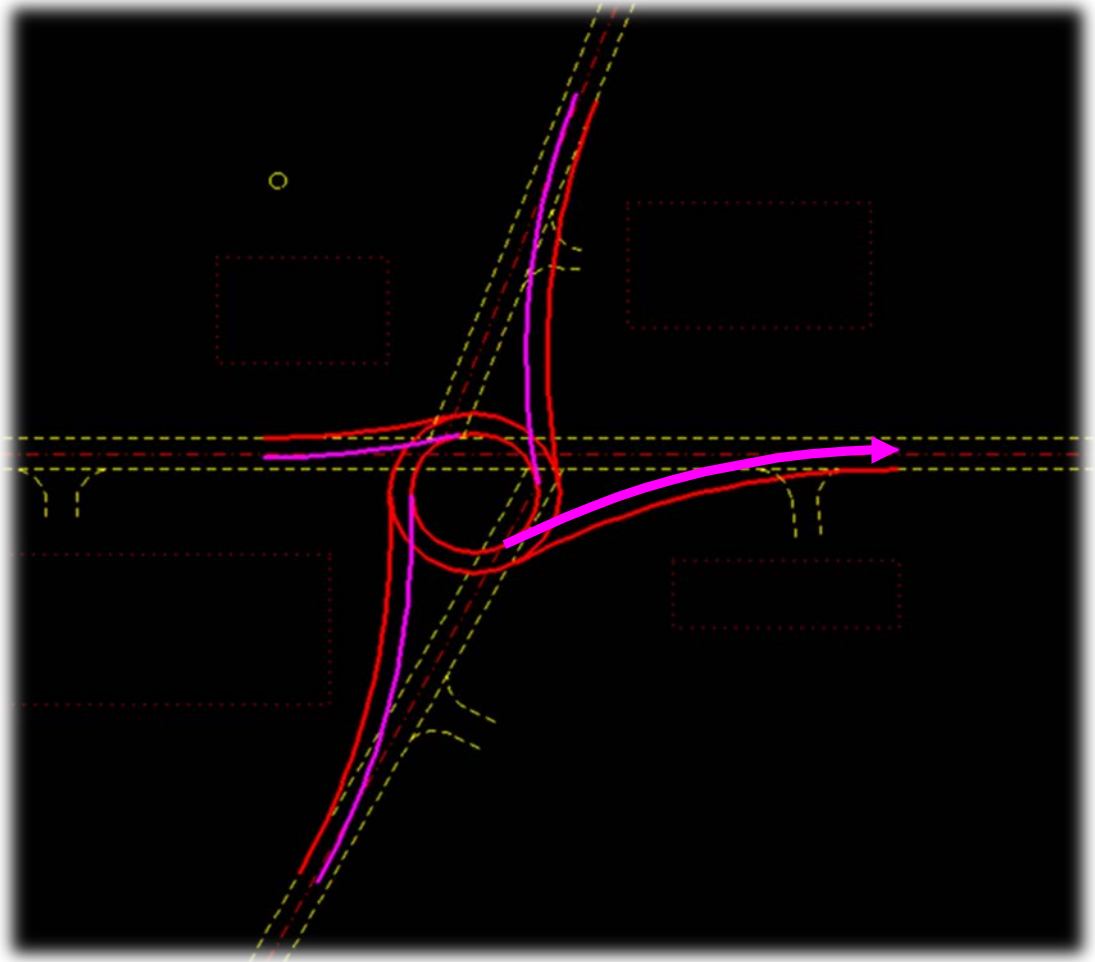
- Draw center circle to maximize deflection on higher speed approach
- Offset for circulatory roadway width
- Draw exits



Single Lane Roundabout Layout

Step 2

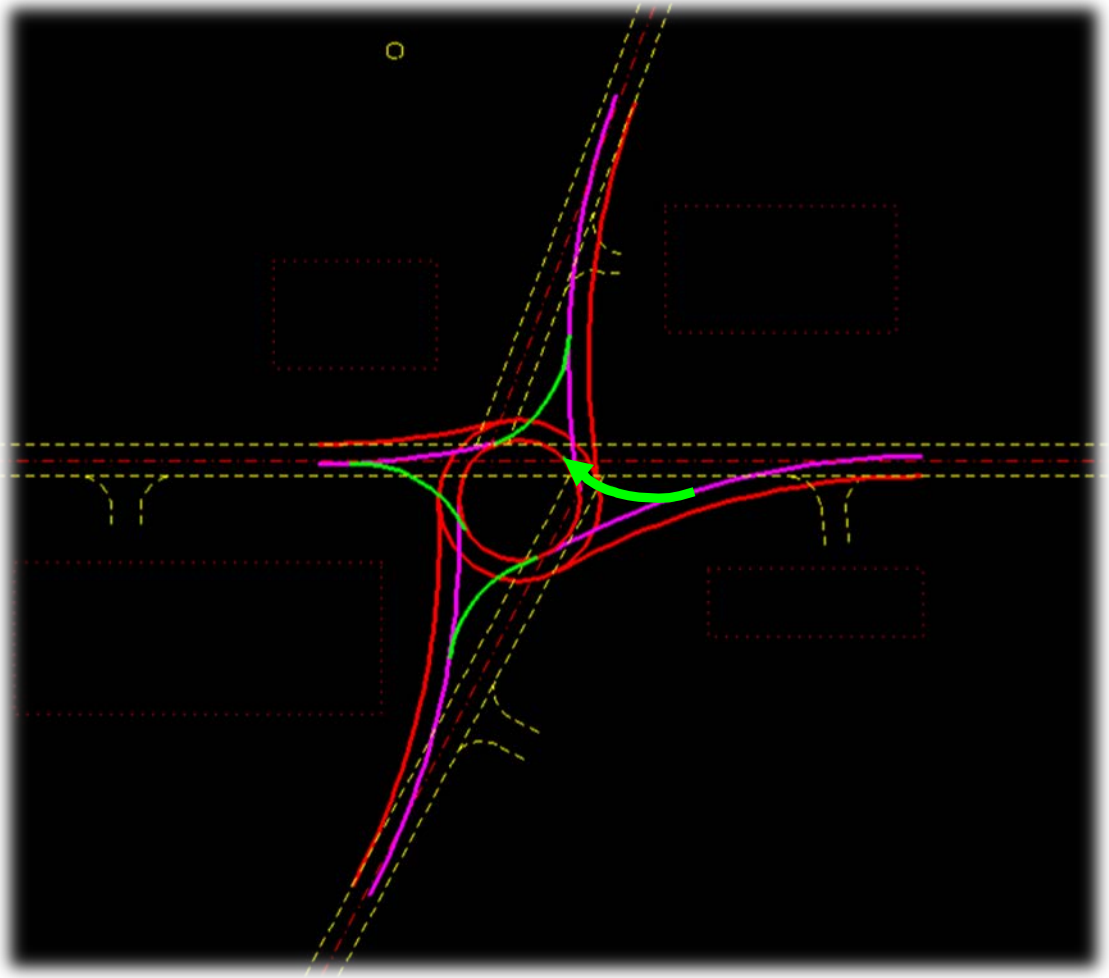
Fillet centerline to inside of circulatory roadway for exits



Single Lane Roundabout Layout

Step 3

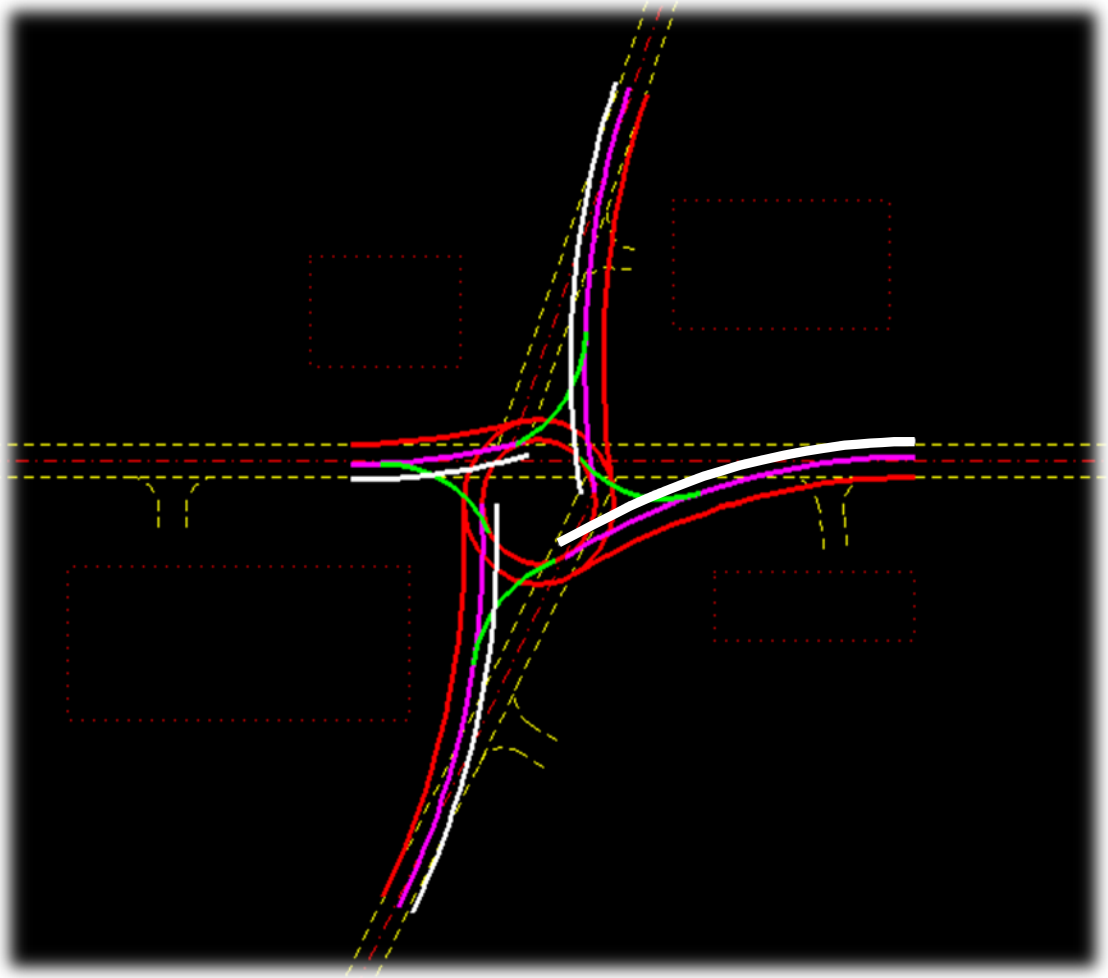
Fillet inside of exit lane with inside circle to create inside approach lane



Single Lane Roundabout Layout

Step 4

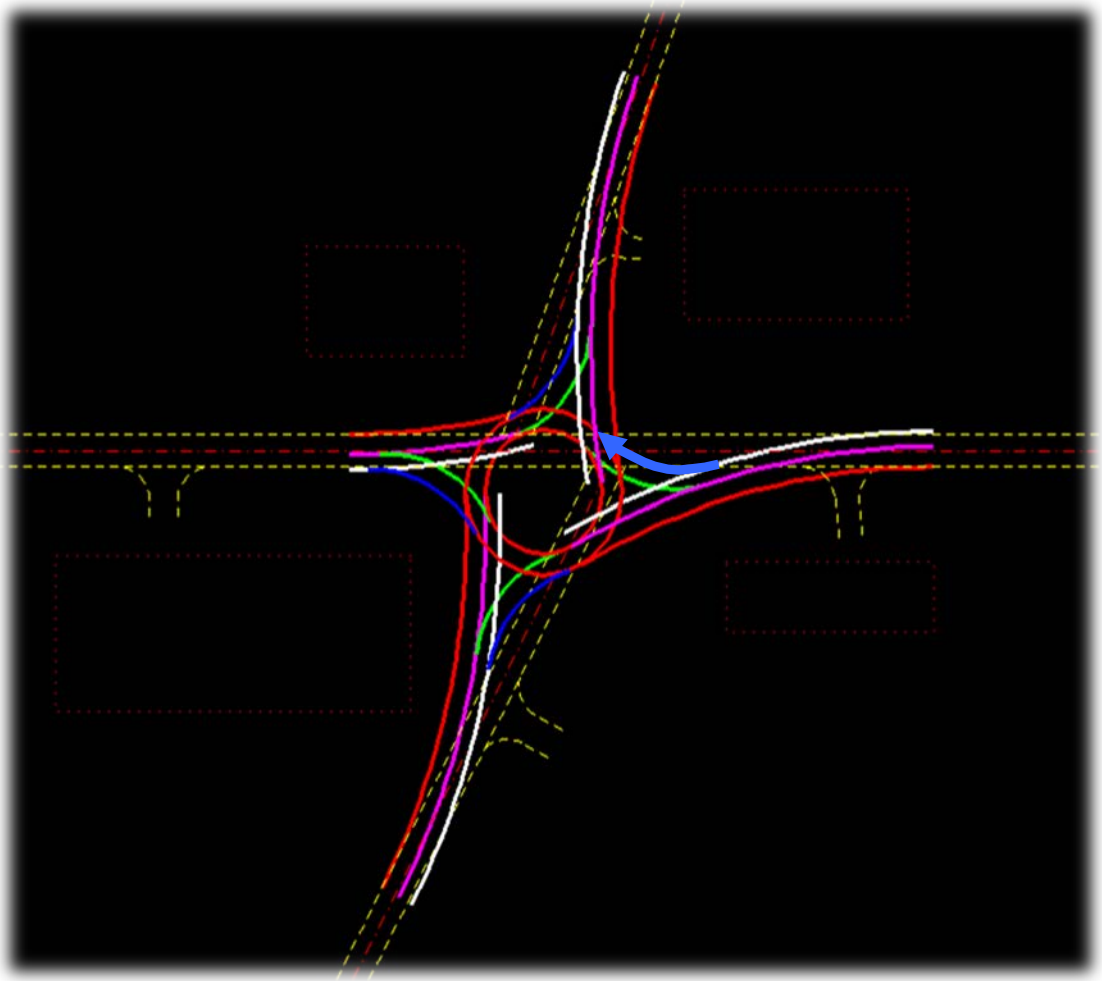
Offset inside of exit lane to match approaching lane width



Single Lane Roundabout Layout

Step 5

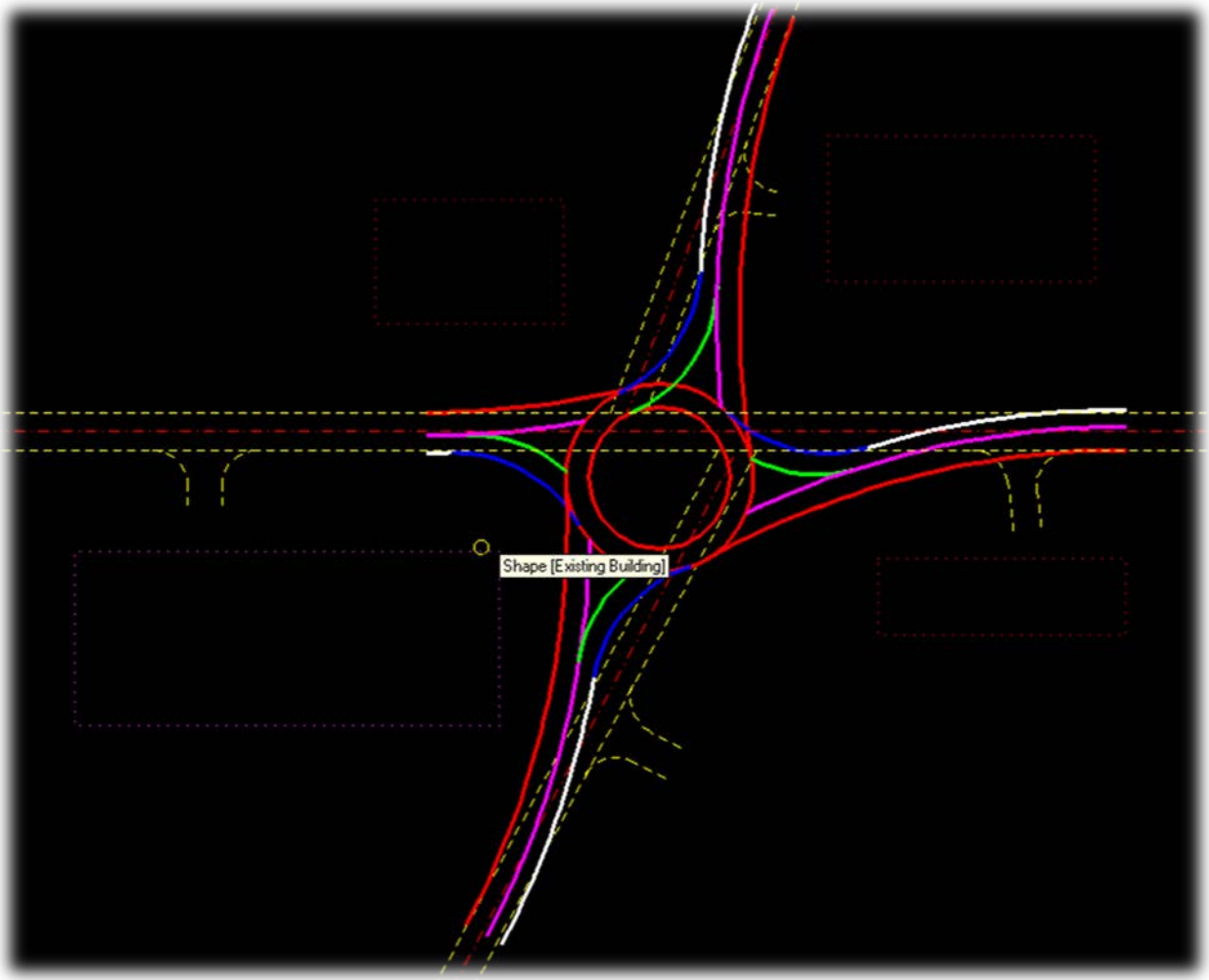
Fillet with outside edge of circulatory roadway



Single Lane Roundabout Layout

Step 6

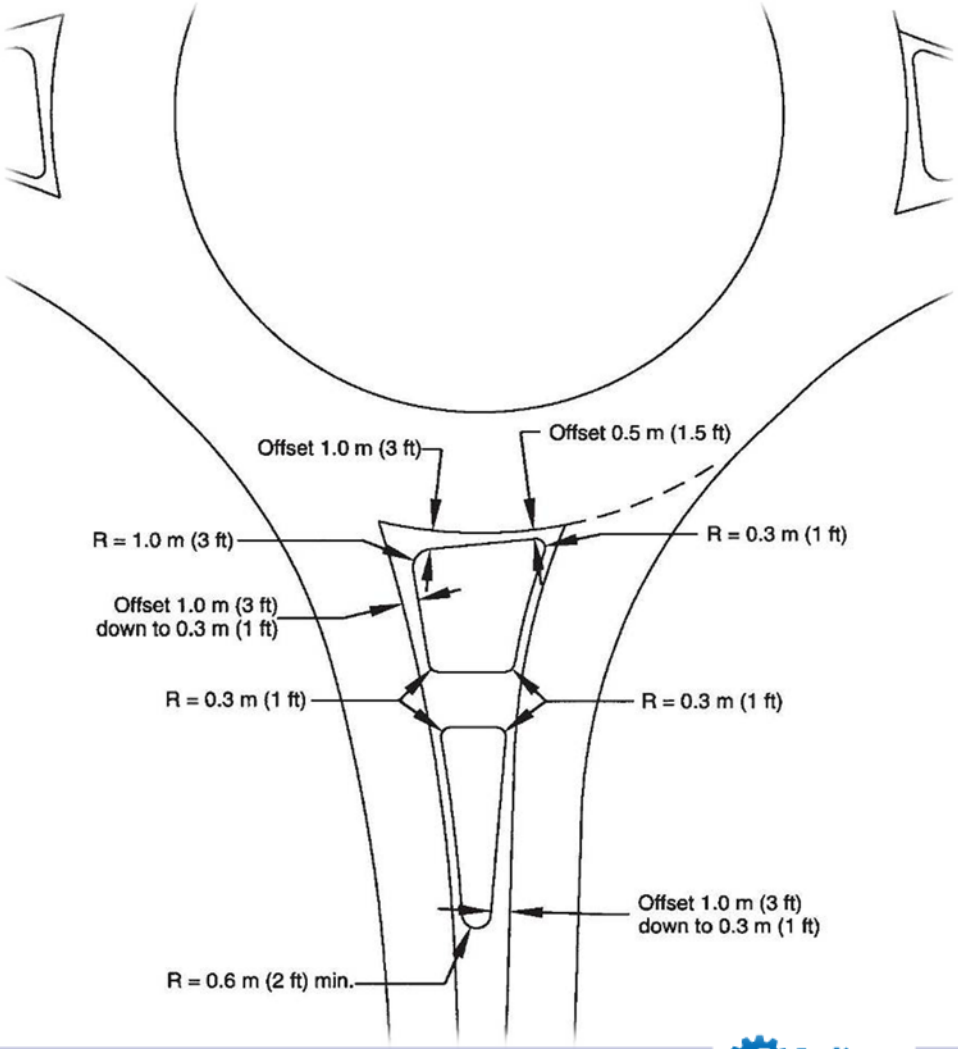
Trim & review your geometrics



Single Lane Roundabout Layout

Splitter Islands

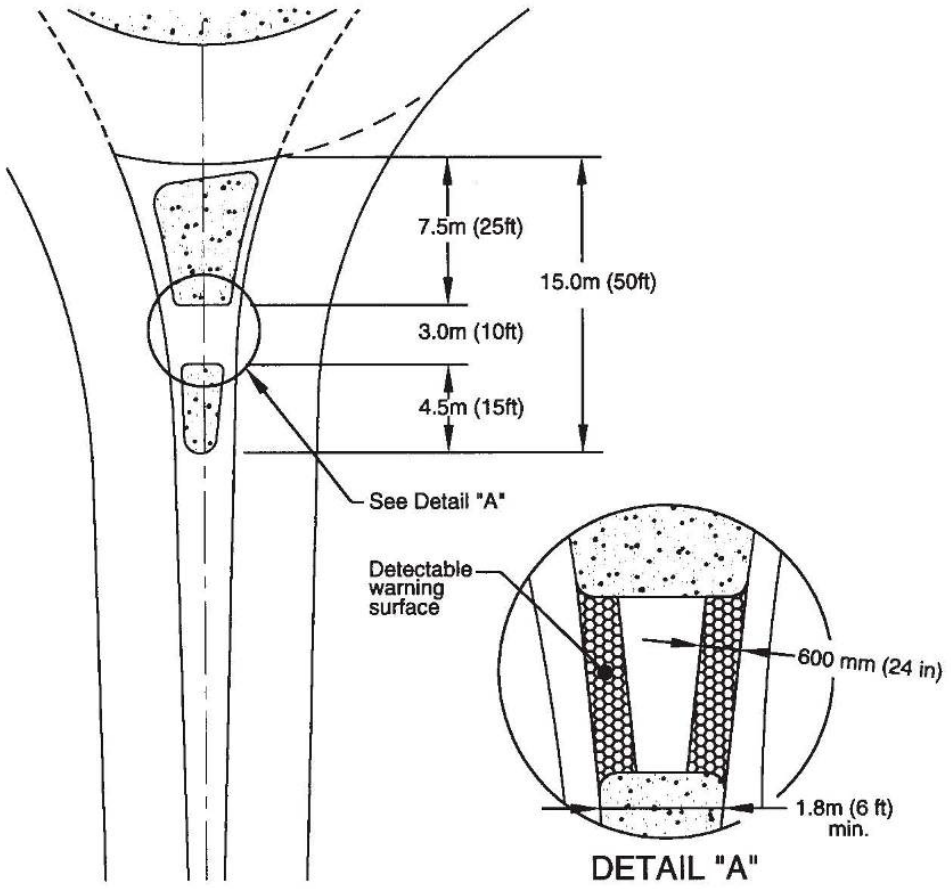
Once layout is complete, create splitter islands as illustrated in Exhibit 6-13 of NCHRP 672



Single Lane Roundabout Layout

Splitter Islands

- Where pedestrian facilities exist, the splitter island should be at least 50’
- Additional modifications to geometry may be necessary to develop required splitter island length



Single Lane Roundabout Layout

Alterations to Geometric Layout

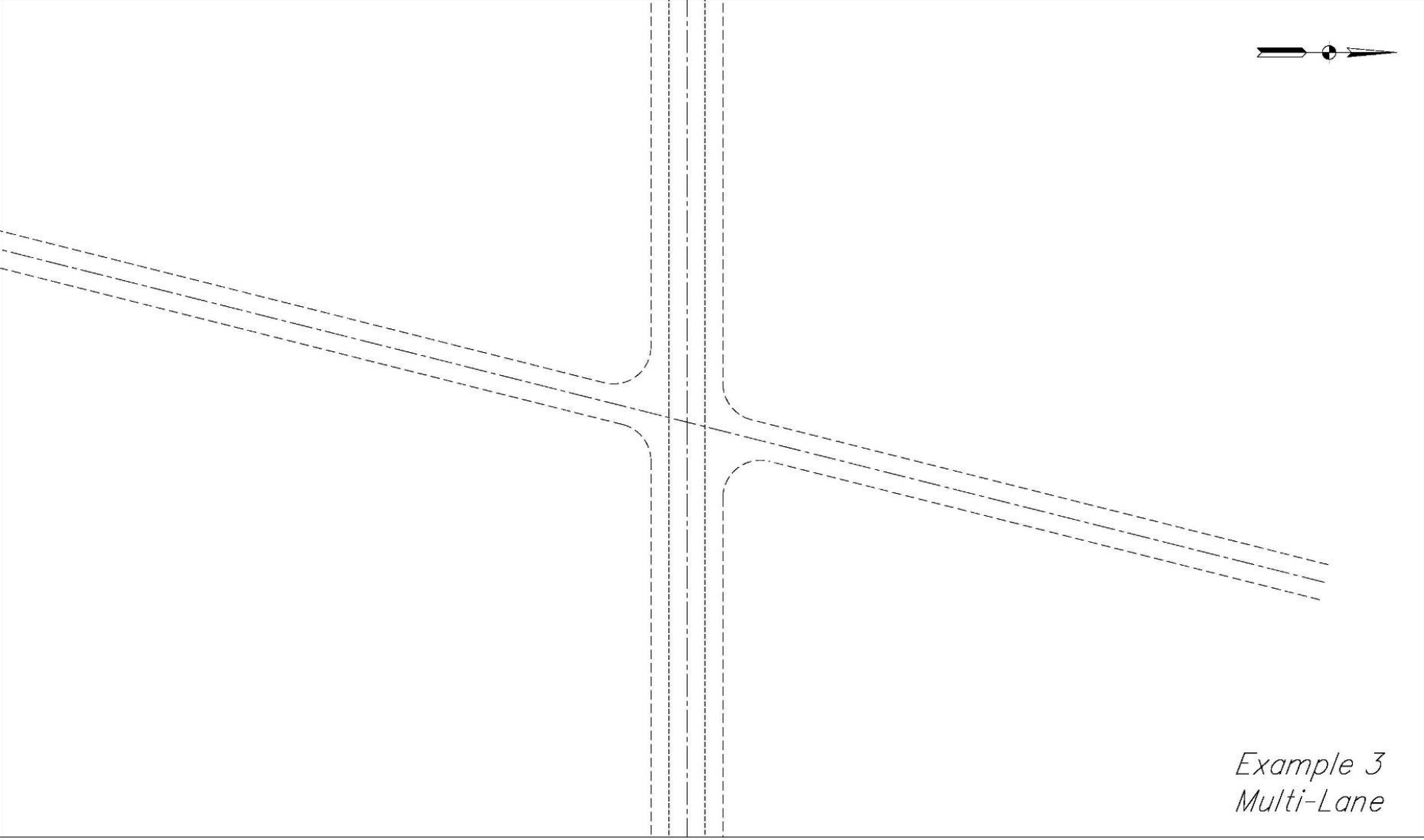
- Can decrease exit radii to avoid R/W impacts or slow exiting traffic due to crosswalk
- Be careful not to reduce exit radii too much
- Can offset centerline in Step 4 additionally to create a longer splitter island
- When a median is involved, in Step 4 you can offset the line to match the inside approach edge of the existing median

Multi-Lane Roundabout Layout

Multi-Lane Roundabout Layout

Geometric Basics

- Inscribed diameter
  - Typically start with 160’ and adjust based on existing conditions
  - Dependent on your design vehicle
- Circulatory roadway width
  - Dependent on your design vehicle
  - Typically start with 30’-31’ for a 2 lane roundabout
- Truck apron width
  - Dependent on your design vehicle tracking
  - Typically start with 5’



Example 3
Multi-Lane

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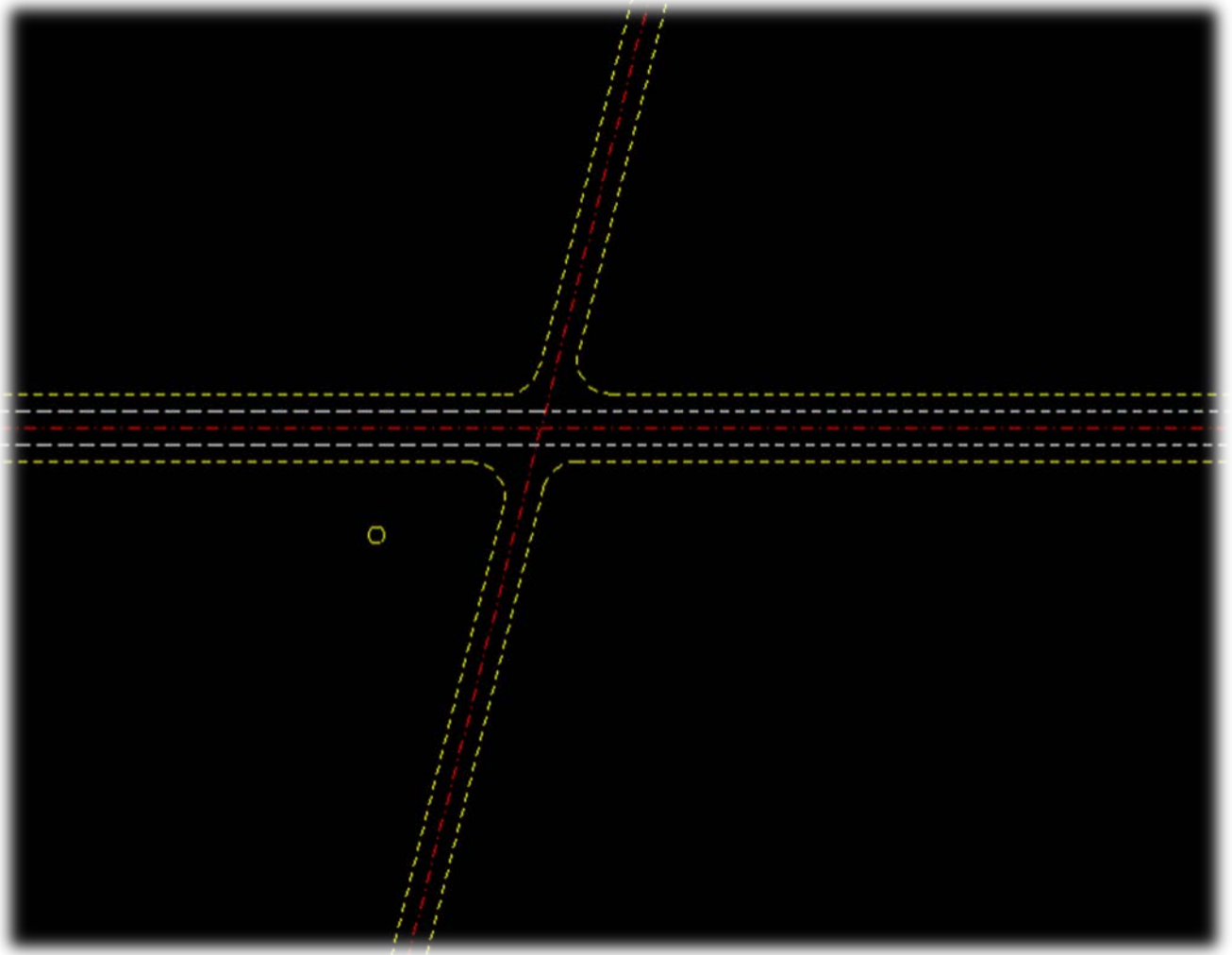
Multi-Lane Roundabout Layout

Situation

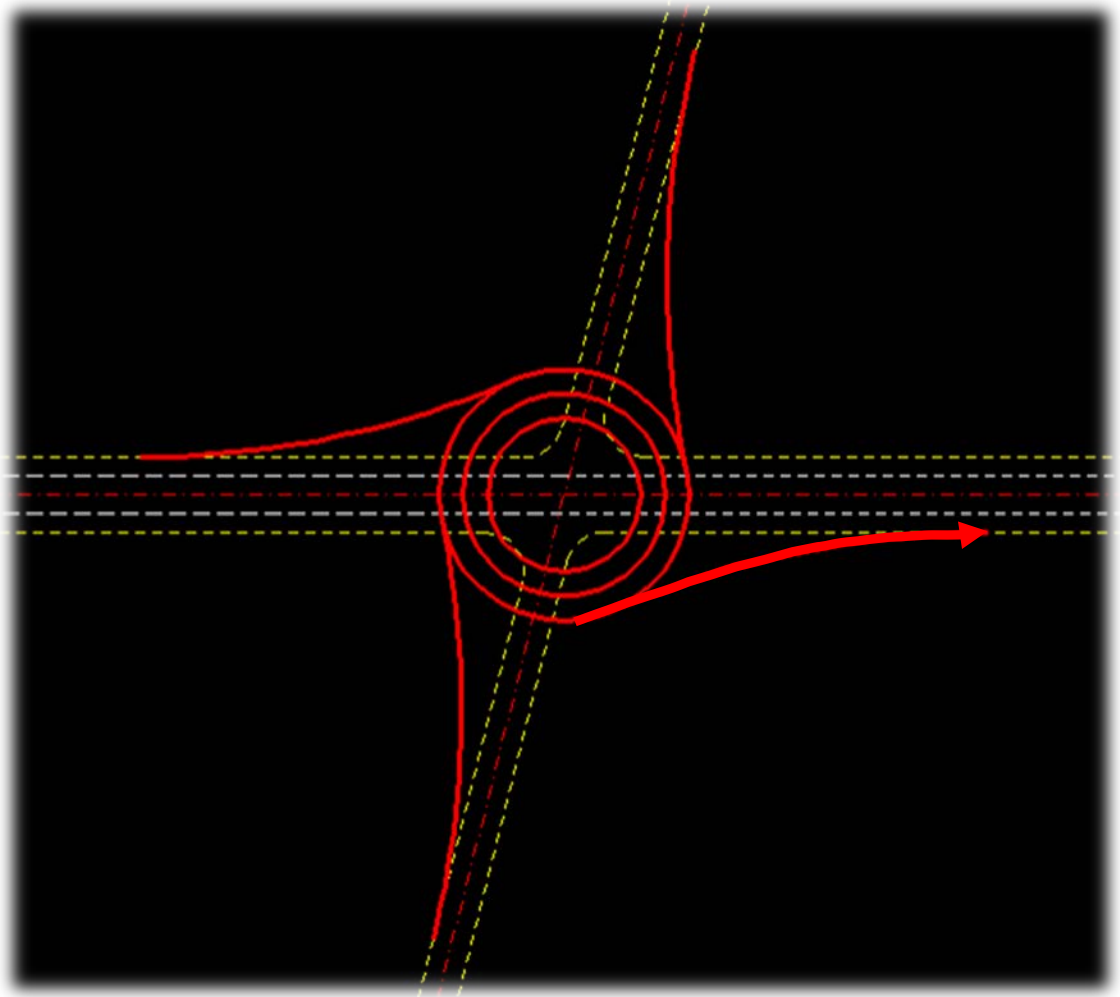
- Skewed intersection
- East-west roadway is a 4 lane facility
- North-south roadway is a 2 lane facility



Multi-Lane Roundabout Layout

Step 1

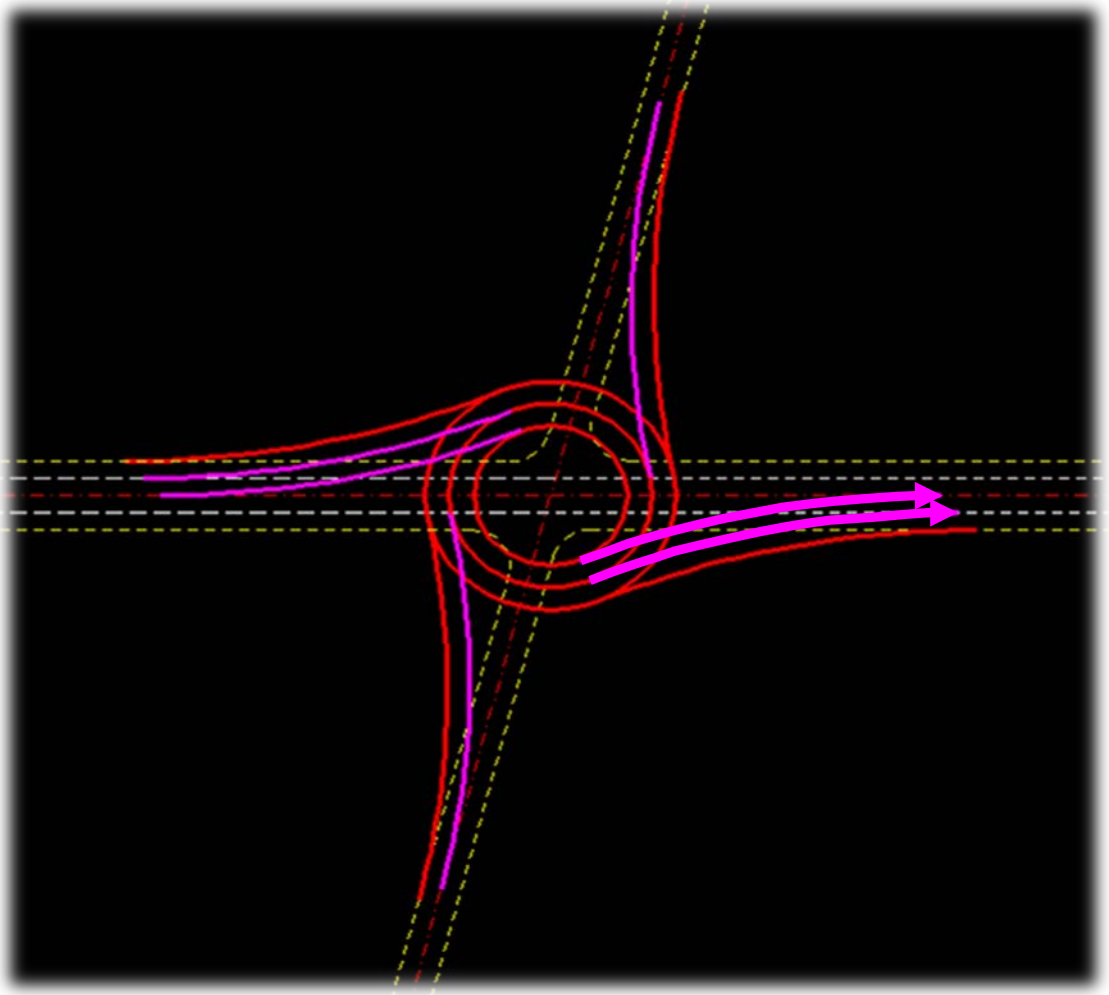
- Draw Center Circle
- Offset for Circulatory Roadway Width
- Draw Exits



Multi-Lane Roundabout Layout

Step 2

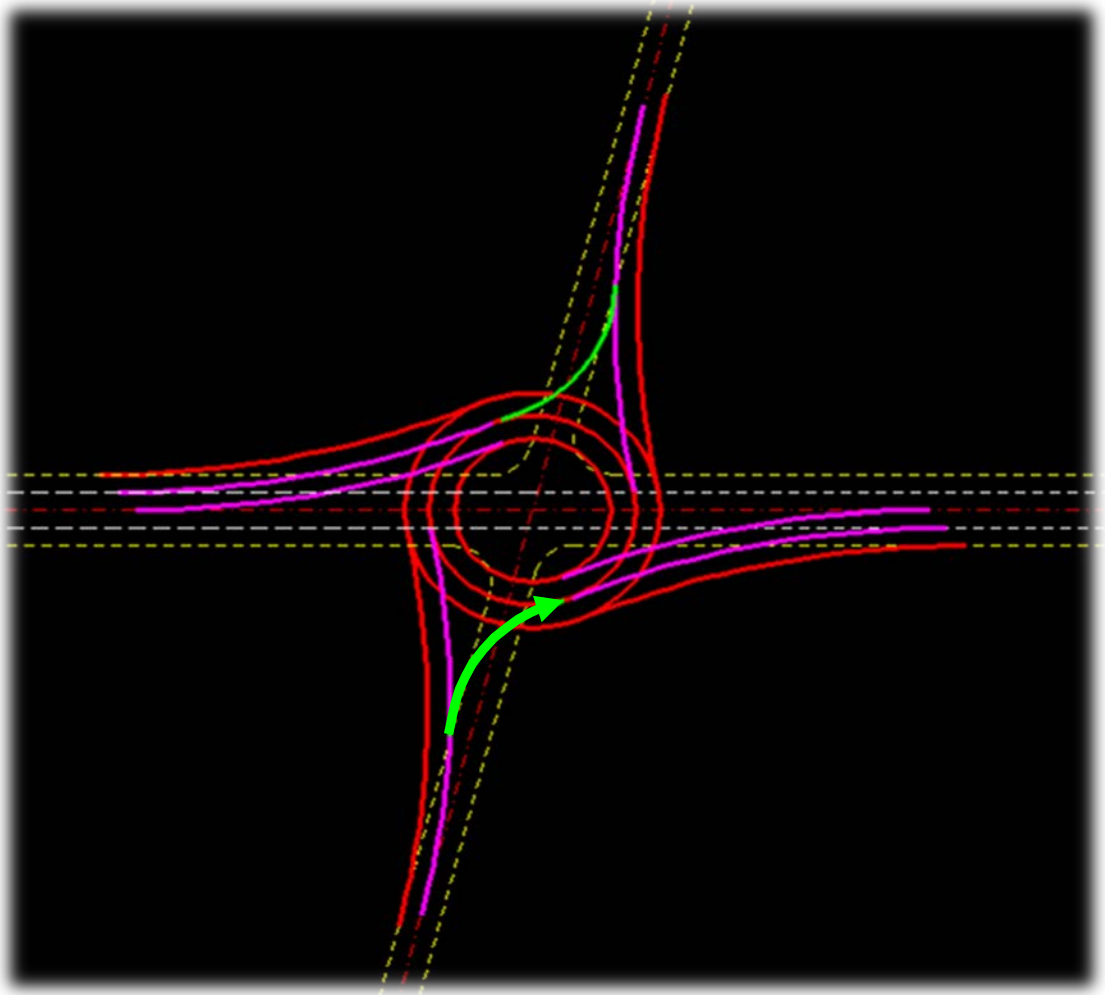
Fillet inside of exit Lanes to inside of circulatory roadway



Multi-Lane Roundabout Layout

Step 3

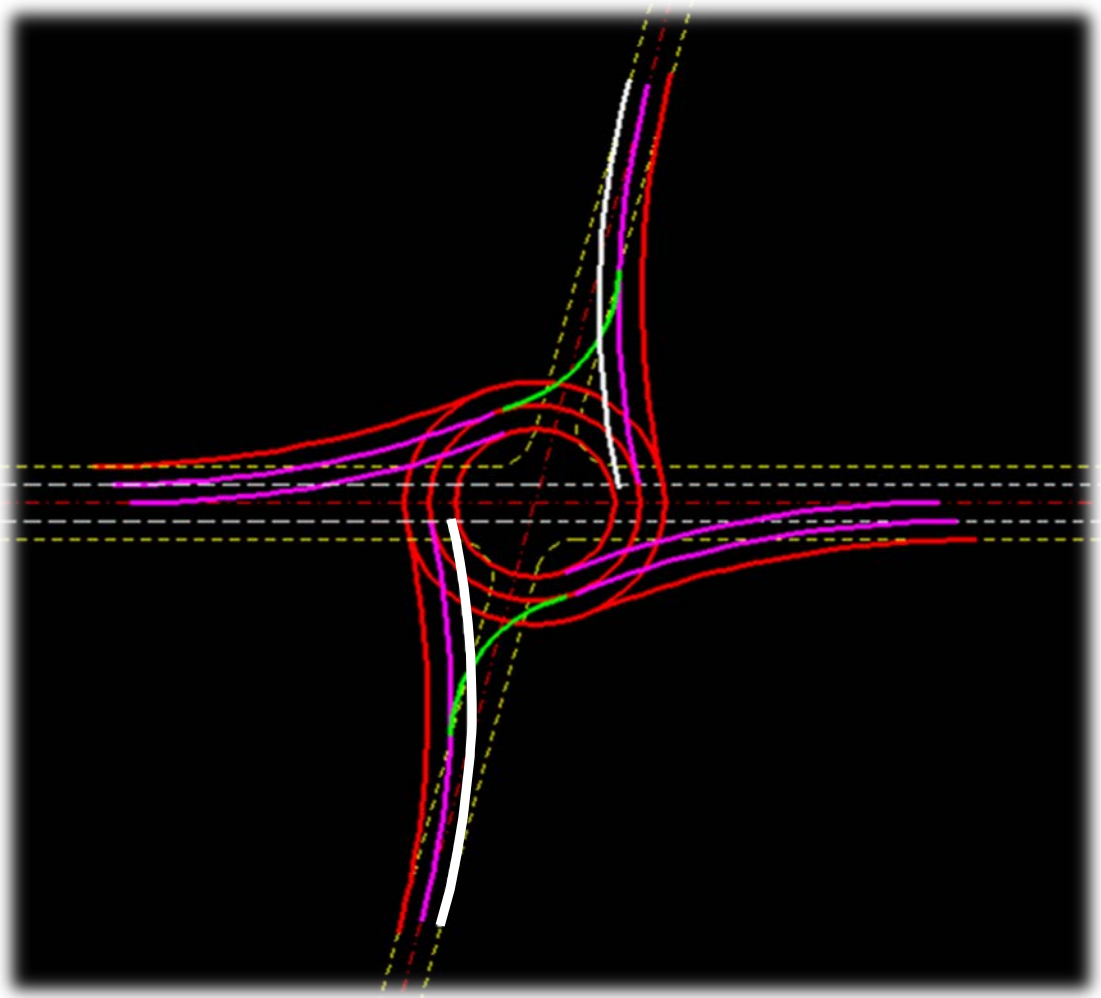
- Fillet inside of exit lane with inside circle to create inside approach lane.
- Only do this for single lane entries!



Multi-Lane Roundabout Layout

Step 4

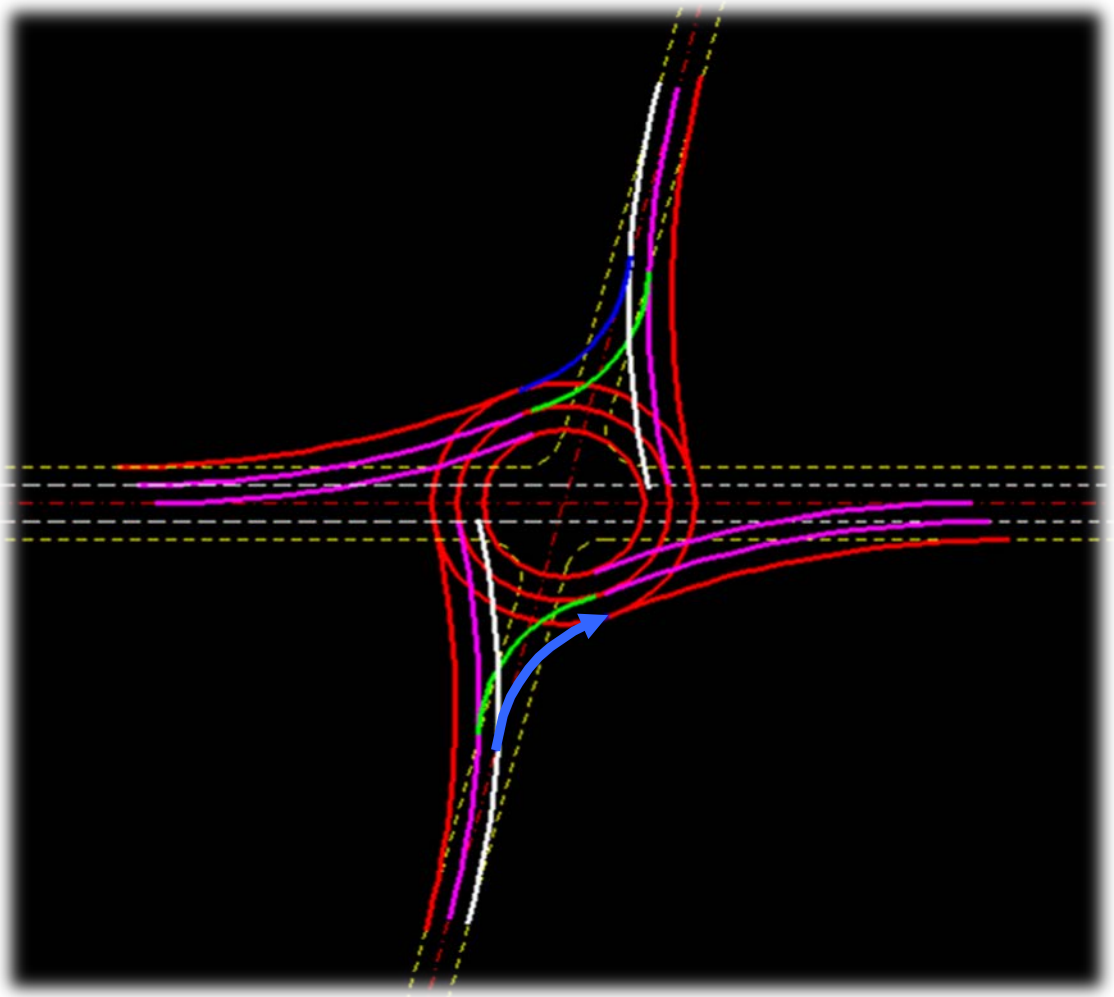
- Offset inside of exit lane to match approaching lane width
- Only do this for the single lane entries!



Multi-Lane Roundabout Layout

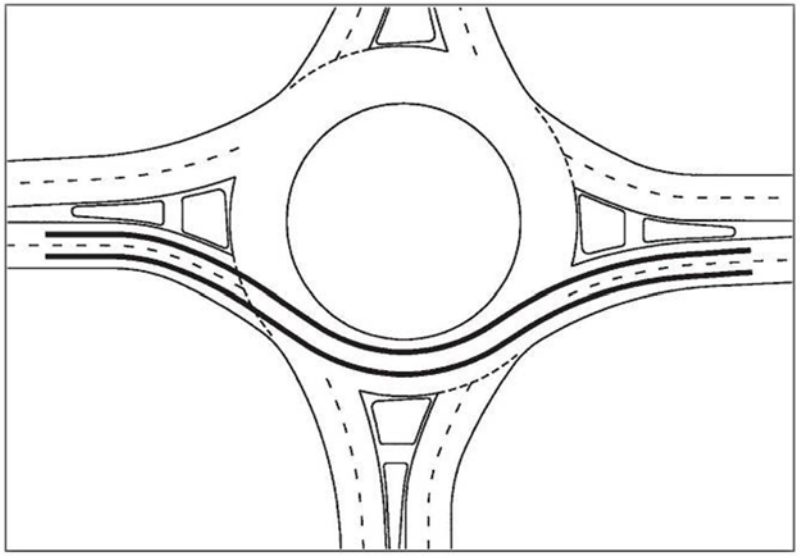
Step 5

- Fillet with outside edge of circulatory roadway
- Only do this for the single lane entries!

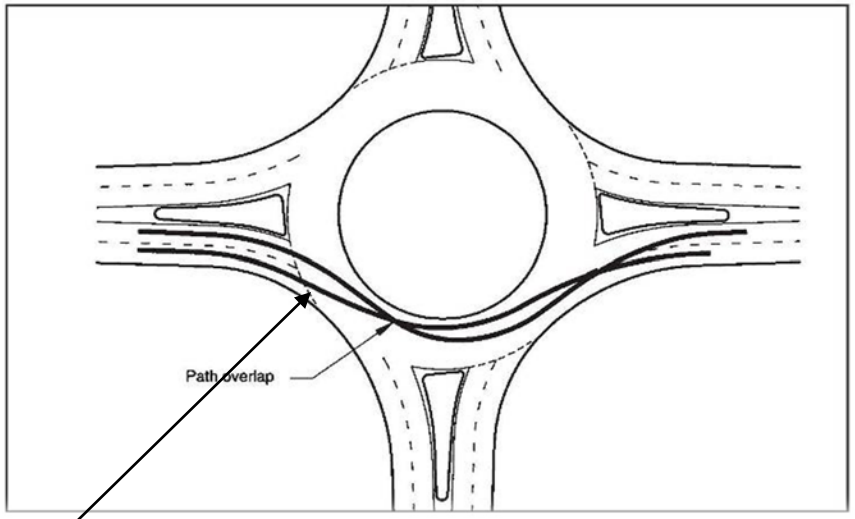


Multi-Lane Roundabout Layout

Desired Path of Vehicles



Entry Path Overlap



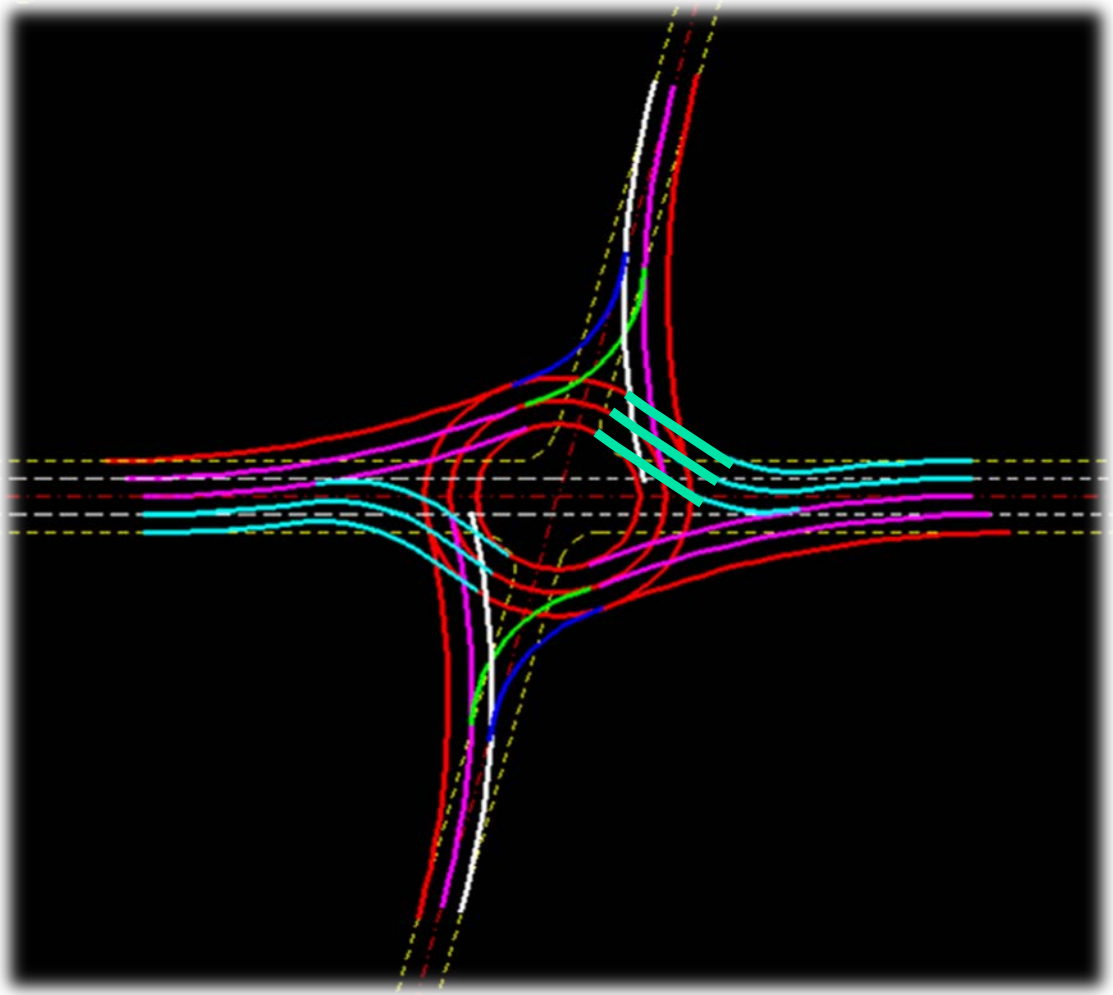
Speed & Trajectory of vehicle at yield point determines natural path

Striping and proper geometric design is crucial to achieving proper lane use!

Multi-Lane Roundabout Layout

Step 6

Create tangents on two-lane approaches to prevent entry path overlap



Multi-Lane Roundabout Layout

Step 7

Trim and review geometry